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Following the text of the book is an advertising section of some 90 pages, carrying the announcements and cards of nearly two hundred manufacturers, dealers in mining supplies, mining companies, engineers, metallurgists, chemists, trade journals, railroads, etc., supplemented by a carefully compiled classified buyers' index.

# PREFACE.

This, the third annual issue of the Copper Handbook, has finally assumed the scope and something of the form originally planned for the work when first projected, nearly ten years ago. The first edition of the work, issued in 1901, was devoted solely to the principal statistics of the trade and to the copper mines of Lake Superior, because it was felt by the author that it was wiser to do a comparatively small work thoroughly, rather than to attempt a larger work and slight the details. In the second edition, issued in 1902, the scope of the volume was materially enlarged, and the principal American mines were treated in more or less detail, the statistical tables amplified and several short chapters devoted to the principal scientific and technical features of the trade were given. References to the copper mines outside of the United States were confined to a dozen pages. The present volume has been strengthened by the addition of a considerable number of new statistical tables, and former tables reprinted and brought down to date have been consolidated in all cases possible, thus effecting a considerable saving in space. These tables are believed to give the most comprehensive copper statistics ever prepared for any work. The chapters devoted to the scientific features of the copper industry have been entirely rewritten and greatly amplified, while a number of new chapters have been added, the part of the book devoted to the history and technics of the trade being about twice the length of the similar section in the last annual issue.

The major part of the book is devoted to descriptions of 2,207 copper mines and copper mining companies in all parts of the world. These have been made as detailed as warranted by importance and permitted by the material secured. In rewriting the descriptions of mines quite fully treated in the preceding volume, not more than ten per cent. of the matter contained in previous issues was used verbatim. In less than a dozen cases are the descriptions the same as in last year's issue, word for word. All mine descriptions of more than a half dozen lines in length have been rewritten upon a rigid plan covering the principal features of interest, the classifications having been divided into twenty-one principal subjects, and sub-divided under nearly a hundred different titles in the case of the larger properties. All old material from former issues was divided under the different headings for each mine, new material added, and the description rewritten in regular order, beginning with title of company or mine, state or country where located, home office address, mine office address, organization, capitalization, finances, officers, etc. This has made slow writing, but it is hoped that it may make easy reading for those consulting the book, which, being intended as a permanent and authoritative work of reference, should be kept absolutely free from all attempts at fine writing, or padding. As a matter of fact it would have been far easier to have written the book to make twice its present size than it was to compress the information into the present form. How forcible this compression was may be inferred from the fact that in the cases of a number of the leading Lake Superior mines the descriptions in the present volume are but one-half the length of the descriptive articles printed in the first volume, yet every essential fact contained in every previous description of every copper mine has been retained in the present issue, and new data of almost equal extent added thereto. In the great majority of mine descriptions the actual writing of the articles as they appear in print has required but a fraction of the time consumed in summarizing the data taken from mine reports, official documents, direct reports from the companies, personal notes and many other sources of information.

While the present volume of the Copper Handbook is a distinct improvement upon the preceding issues, it is by no means put forth as a perfect work, for nobody could be more sensible of its imperfections than its author. It is given to the public, however, with a reasonable degree of confidence, based upon the favor with which the former editions have been received. Every reader is invited to act as a critic, and corrections of errors will be received as a favor. In a work of more than 600 pages, treating of the entire copper industry and listing more than 2,200 different mines and alleged mines in every part of the globe, errors cannot be avoided, and it would be preposterous to claim infallibility. All that the author asks is that the reader will credit his intention to deal fairly with every property, to give the facts obtainable without fear or favor, and to use every precaution in his power to verify every statement of fact or opinion.

The author is greatly indebted to many kind friends, resident in scores of different countries, for assistance rendered in the way of special and general reports upon various mining fields and individual properties. Such information is solicited, from any honest source, for future editions of the work.

HORACE J. STEVENS.

*Houghton, Michigan, February* 28, 1903.

# INTRODUCTION.

The reader is requested for his own benefit to glance through this brief introduction to the Copper Handbook. This work has been prepared upon systematic lines throughout, and while the plan followed is not perfect, and doubtless will be modified and improved in future editions, the reader may benefit by understanding the system that has been followed, when using the volume as a reference book or otherwise.

The table of contents, which appears next after the title page, gives the various chapters of the book. The index, following the book proper and preceding the advertising section, will be of aid in facilitating quick reference to any table, district or other subject on which information is required. For those wishing to use the handbook as something more than a dictionary or encyclopedia on copper, the following outline of the plan on which the book is prepared may be of assistance.

The subject of copper is taken up in a historical way in the first chapter. While this treats of salient features, more detailed historical matter will frequently be found, first in the chapters treating in detail of the copper deposits of the world, and secondly, in the descriptions of the various copper mines.. The chapter on geology is short, but there are innumerable additional references to the geology of the various districts and mines, in the chapters on copper deposits and the detailed descriptions of copper mines.

The chemistry and mineralogy of copper, its ores and alloys, are treated in considerable detail in the chapter devoted to those subjects. The chapter on metallurgy has also been rewritten and greatly amplified, This is followed by a new chapter on the uses of copper. The glossary comprising the sixth chapter gives about twice as many definitions as in last year's issue, and, except for terms appertaining exclusively to coal, iron and gold mining, will be found an exceptionally complete lexicon of general mining terms.

In the eight chapters devoted to the various copper deposits of the world, there are brief summaries of geological conditions and developments in the various copper-bearing countries. Chapter XV, comprising the greater part of the book, lists some two thousand five hundred copper mines and copper mining companies. Regarding each of these mines and companies there appears more or less detailed information, very scanty in some cases and very copious in others, according to the real importance of the property, except in some cases where it has been impossible to secure wished-for particulars in time for incorporation in this volume. In future editions the weak spots will be strengthened, so far as patient research will permit.

The final chapter of the book proper is entirely statistical. It represents much hard work and prolonged collection, comparison and investigation of figures. In some cases these statistics show material variations from the commonly accepted figures. In such cases, the figures in the book represent the truth as understood by the writer. The author of this work wishes expressly to disclaim all pretence to infallibility; neither does he desire to attempt to elevate himself by pointing to the errors, real or imaginary, of other authorities. No man is infallible, and no wise man imagines he will raise himself by pointing to the mistakes of others. Where the figures herein differ from those commonly accepted, it is because the compiler believes his statistics to be more nearly accurate, for various reasons that can be supplied, if necessary. Just as the man that captiously criticises is guilty both of bad taste and a tactical error that will ultimately redound to his own discredit, so it may also be said that the statistician who is not willing to put forth his own figures, after careful verification, even though in the face of strong authority, has no business to pose as a statistician. He is merely a computing machine, requiring supervision, and of his own initiative can do naught and become naught.

I would suggest that my readers, all of whom it may be safely presumed, are interested in the subject of copper in some way, should read the first fourteen chapters of the book, also study the statistical chapter. As for the detailed mine descriptions, only those desired need be read, but a perusal of the preliminary and statistical chapters of the Copper Handbook will prepare all readers, except those that have made a life business or a profound study of the subject, for a more intelligent understanding of the descriptions of the particular mines they may be interested in, or a better comprehension of the particular branch of the copper industry on which they may desire information.

Not the least interesting or least valuable part of this volume is the advertising section. In this will be found the announcements of many of the leading manufacturers of mining machinery and dealers in the supplies required for mines, also the announcements of trade journals, which are, in themselves, indispensable to those interested in these particular fields. There is also an interesting section devoted to the cards of copper mining companies and a third section containing the advertisements of mining engineers, metallurgists, chemists, assayers, and other professional men engaged in various capacities in the great industry of mining. It has been my effort in this, as in previous editions, to secure the advertisements of reliable firms only, and such as while reasonably sure to receive benefit from the circulation of such a work as this, will also add directly to the value of the book itself by affording a trade and professional directory, in the pages of which can be found the announcements of men and firms capable of supplying any and every want of mine, smelter or manufactory, from professional skill to every article needed in the installation of the most modern and efficient plant.

# THE COPPER HANDBOOK

## CHAPTER I.

### THE HISTORY OF COPPER.

The discovery and utilization of copper occurred at a period so remote that even legendary accounts are lacking. A semi-authentic narration of the facts connected with the discovery of iron on Mount Ida has been handed down to us, yet there were copper mines worked on this same mountain in Asia Minor before the alleged date of the discovery of iron. The earlier history of the useful metal is surrounded by the same myths as cloud the story of mankind in general in days so far remote. There seems good reason to think that copper and tin, in the form of bronze, an alloy of these two metals, was in general use before the discovery of the process of producing iron from its ores. Such was unquestionably the case with the primitive peoples of Northern and Western Europe. In Asia Minor, the scene of the earliest civilization known to archæologists, many weapons, implements and ornaments of bronze have been found in buried cities of seven to eight thousand years of age. On the American continent the aboriginal peoples were unacquainted with the use of iron, but the richer and more advanced nations had great stores of copper, gold and silver. The latter metals, found in profusion in Mexico and Peru, were utilized mainly for ornaments and decorative architecture. There being no important tin deposits as yet developed in the new world, and there being no evidence that tin was mined on the North and South American continents before their discovery by Europeans, it seems altogether probable that the aboriginal American aces were totally unacquainted with bronze and brass. However, copper itself was used extensively. It was mined from Lake Superior deposits of native metal in very considerable quantities, and was distributed at least as far south as Mexico, and to practically all parts of the territory now constituting the United States. The date at which this mining was done is variously estimated at some hundreds to many thousands of years ago. The Chippewa Indians were in possession of the southern shore of Lake Superior when it was visited bv the first white explorers, the intrepid Jesuit missionaries, Rene Mesnard and Claude Allouez, early in the Seventeenth century; Father Mesnard, the first white man to set foot on the shore of the great fresh water sea, having lost his life a few miles from where the greatest copper mines of Lake Superior are now developed. The Chippewas were then unacquainted with any of the practical uses of copper, though possessing a few small masses of the native metal, saved apparently for the same reason that impels a child to collect bright colored bits of broken glass. The Indians not only made no practical use of copper, but were unacquainted with the use of any other metal. As extensive mining operations were formerly carried on in the district held by the Chippewas in the middle of the Seventeenth century, the last actual mining must have been done at least several hundred years earlier, or some oral traditions would have been handed down. Whether the mining was done by ancestors of the aboriginal tribes discovered in possession of the Lake district by the earliest white explorers, or by some antecedent people of higher civilization, is a point that archæologists and ethnologists are still arguing. Whatever may have been the derivation or fate of that pre-historic race of copper miners, vaguely termed "Mound Builders," it is certain that they enjoyed at least a rudimentary civilization, and were successful metallurgists, for they possessed the art of tempering copper. Weapons for the chase and war and domestic utensils of good finish and style, and highly tempered, are dug from mounds and found in sand dunes along the southern shore of Lake Superior from time to time. In this connection, it may be observed that many zealous metallurgists, mostly of the amateur stripe, are wasting much time in efforts to re-discover the "lost art" of tempering copper. Sundry fairly successful processes for tempering copper are now known to scientists, but the art, even if again brought to its pristine perfection, would be of no great benefit, as steel and iron are much cheaper than copper, and far preferable for any ordinary use to which tempered copper could be put.

From the earliest dawn of history, copper and gold seem to have been in common use among the more civilized nations, the yellow metal for ornaments and as a medium of exchange, and the ruddier one for weapons and implements, usually in the form of an alloy, as brass or bronze. The ancient world of Grecian and Roman days possessed considerable stores of copper, and mines were regularly worked. There are apparently good reasons for believing that the Phœnicians knew of the tin and copper deposits of Britain at a period as remote as 1,000 B. C. Spain was the source of the principal copper supplies of the Roman empire, although other fields were also worked to some extent. Spain has been furnishing copper to the world for nearly three thousand years, and remains one of the principal sources of the world's copper supply.

During the dark period of the middle ages, mining, while not a lost art, was certainly not followed as systematically and successfully as during the more prosperous and enlightened era of Roman dominion. The world's supply of gold and silver decreased from century to century, owing to the losses from attrition and misplacement not being made good by the quantities mined. Iron, being subject to rust, was mined and smelted as required, although the production was surprisingly small. It is probable that the

United States Steel Corporation now turns out in every working day more iron than was produced in all Europe in a full year, at the period of greatest darkness during mediæval times. The supply of copper during the middle ages must have been very small, but the science of statistics was not then in vogue, in a period when a king was called Beauclerc—good clerk—because he could write his own name without the guiding hand of a monk.

When Europe awoke from the lethargy and sodden life of the dark ages, in the Fifteenth century, the use of the metals began growing, and this growth has continued, with few interruptions, to the present day. The tin and copper mines of Cornwall became sources of great wealth to their titled owners, and the mining of copper was stimulated in Germany, Norway and other European countries. In the Eighteenth century copper mining was started in the American colonies of Vermont and New Jersey. In the Sixteenth century copper was discovered in Mexico and several parts of South America, but the Spanish conquistadors were more anxious for the gold of the Peruvian Incas, and the silver from San Louis Potosi, than for the cheaper metals.

At the beginning of the Eighteenth century the English mines, in Cornwall, were making much the largest part of the world's copper, and even at that date were of such considerable depth and with such extensive underground openings that the problem of disposing of the water was of the most vital importance. Many good mines were allowed to remain idle, solely because the expense of keeping them free of water was greater than the profits of operation. The first steam engine was built for a Cornish mine, the Wheal Por, by a Captain Savery, very early in the Eighteenth century. It was but a partial success, and the plan was improved on by Newcomen, who erected a pumping engine at the Wheal Fortune mine, Cornwall, in 1720. The Newcomen steam engine was a crude and wasteful device, according to the standard of the present day, but it was much more effective than hand and horse power, or a water wheel, and was used in many of the larger Cornish mines for fifty years or more, until the genius of Watt brought forth the modern steam engine—an engine that a century and a quarter has been unable to improve upon in essential plan, though many and great betterments have been made in details. It should be said, however, for Savery and Newcomen, that crude as were their steam engines, the pumping plan followed by them was essentially sound, and the Cornish pump, first made by Savery nearly two hundred years ago, and improved a little later by Newcomen, is still the basic model for the Cornish mine pumps, scattered over the habitable world, wherever there are mines.

The first Watts engine was erected at Chacewater, Cornwall, in 1777, and proved a great success. It came none too soon, as the larger mines, deepened by reason of the aid given from Newcomen's pumps, were at a depth where the first crude engines could no longer give satisfactory results.

Although steam power was first applied to copper mining nearly two centuries ago, it was used only for handling water until after the beginning of the Nineteenth century. The first application of steam power to other mining uses was in the first or second decade of the Nineteenth century, when a hoisting drum was first actuated by steam.

At the beginning of the Eighteenth century Great Britain was making at least three-quarters of the world's copper. The Cornish mines produced 4,923 tons of refined copper in 1799, and the Welsh mines of Anglesea made nearly 2,000 tons in the same year. The great Mansfeld mine, in Germany, made only 372 tons in that year, and only estimates are obtainable for the products of other countries. Spain's output was insignificant, and the United States made but a few tons. Russia and Japan probably ranked next in importance after England as producers, and Austria, Norway, Sweden, Italy and several other nations made small contributions to the world's copper stock. Australia, South Africa and Canada were then unknown as sources of copper supply. It is a notable fact that one hundred years ago, the mines of the United States, Spain, Chile, Mexico, Canada, South Africa, Australia and Tasmania, which now make about 90 per cent. of the world's copper, were either totally undeveloped, or else producers of but a few tons each, while Great Britain, which made almost 7,000 tons of copper in 1799, produced but 550 tons in 1899.

For the first half of the Nineteenth century, Great Britain maintained its position at the head of the world's copper producers, but the latter half of the century was a period of ever increasing depression, relieved by only occasional years of prosperity for the British copper mines. The invention of the Watts engine and its application to pumping machinery enabled the mine operators of Cornwall and Anglesea to penetrate to depths theretofore undreamed of. In 1790 the Dolcoath mine in Cornwall was 600 feet deep; in 1816 it was down 1,368 feet, and in 1830 the Tresavean mine, also of Cornwall, reached the great depth of 1,920 feet. As the mines increased in depth rapidly, various improvements became necessary. The old method of raising ore in baskets carried up ladders on the backs of men and women was replaced by whims, operated first by hand, then by horse power, later by water wheels, and eventually by steam. Around these whims were coiled the ropes that hoisted ore in wicker baskets. A little later the hempen ropes were replaced by wire cables, and the baskets gave way to iron skips and cages. In 1842 the first man engine was built, for taking men to and from their work in the deep mines. Mine surveying was introduced, and machinery employed in the mills, where hand work had been the rule for centuries. The Anglesea mines enjoyed great prosperity for the first quarter of the century, but gave unmistakable signs of exhaustion a few years later, and in the fourth decade ceased to be important factors in the world's copper industry. The smelters of Wales had attained such growth, however, that Swansea still remains the seat of one of the greatest and most diversified smelting industries of the world.

It was in the fourth decade of the last century that the competitors destined to destroy the English copper mining industry first began coming to notice. The copper discoveries in the Lake Superior district were made at about the same time as copper in workable quantities was found in Australia, but the Australian mines were of slow development, and have never grown to be of great importance, while the Lake Superior mines soon became the largest of the world. The first actual copper mining at Lake Superior was done in 1844, and the first product secured was a few tons of oxide ore—not native copper—taken from a fissure vein near Copper Harbor, Keweenaw county, by the Pittsburg & Lake Superior Mining Company, which later developed the Cliff mine, nearly twenty miles to the southwest. The Minnesota mine in Ontonagon county was opened shortly after, and since that time the Lake Superior copper industry has enjoyed a large and fairly steady growth.

Beginning in the early fifties, the Chilean copper deposits were systematically developed and Chile has become one of the world's greatest producers. The Tharsis mine in Spain, was re-opened in 1863. It was in the sixties that the competition of cheaper copper from richer mines first begun to be felt most severely in Cornwall, resulting in the closing of one mine after another, until today, the Cornish mines in active operation are few in number and their profits trivial.

The awakening of Japan by Commodore Perry in 1854 was succeeded by a period of angry contempt for foreign manners and methods on the part of the Japanese, but this was followed by the revolution wherein the shogun was deposed and the mikado became the actual instead of the merely nominal ruler of the island empire. The introduction of foreign methods has been followed by the industrial awakening of Japan, and the Japanese mines are now sources of copper supply of great importance, and even greater promise.

In 1866 the Calumet & Hecla was opened and speedily took first rank among the copper mines of the world. In 1876 the great Rio Tiano mines of Spain were reopened, after a century of idleness. The Moonta and Wallaroo mines were opened in Australia at about the same time as the Calumet & Hecla, and Tasmanian copper deposits first attracted attention in the same decade, though no considerable production was secured until nearly twenty years later.

In 1880 the Butte camp of Montana, now the greatest copper producer of any district in the world, was discovered. Butte was originally a placer gold camp, and the first Butte copper mine, the Anaconda, was opened for silver, and eventually became the largest copper producer of any of the world's mines. In the latter eighties, South Africa developed several good mines; the Boleo and other Mexican mines became prominent, and the first great mines of Arizona were opened.

The beneficial influence of the copper industry upon the mining and metallurgical methods of the world has been most marked. The first smelting was probably done from copper ores. The Bessemer process is used in copper refining as well as in the making of steel. Many important advances in metallurgical processes have been contributed by copper smelters, and of these, the latest, and perhaps the greatest, is electrolytic refining, which will be found treated of more extensively in the chapter on metallurgy.

In the improvement of actual mining processes, copper mines have led the world for two centuries. The first successful use of steam was in copper mines, nearly two hundred years ago, and iron skips and cages, iron and steel cables, high explosives and power drills, were first used in mines of copper, during the century just closed.

The copper mines of Lake Superior lead the mines of the world in the depth of their openings and in the capacity and economy of their hoisting, air compressing, and pumping engines. The Anaconda copper mine, in Montana, possesses a concentrating and smelting plant with a daily capacity for treating more than five thousand tons of ore, and compared with this gigantic smelter, all similar plants in the world appear like pigmies.

The copper mines have led in the introduction of new methods and machinery, and they have led in the production of the great miners of the Eighteenth century. Great operations call for and develop great men, and the mineral industry of the globe owes much to the copper miners, for they have blazed the rough trail that the feet of myriads of followers have trodden into the broad highways of modern mining practice.

After briefly reviewing the history of copper in the centuries past, from the days of King Sargon to the close of the wonderful Nineteenth century, it seems fitting, now that we have entered fairly upon the Twentieth century, so pregnant with promise of achievements surpassing all that have gone before, to review briefly the present condition of the world's copper industry, and even to forecast in some degree the developments of the immediate future. To dogmatize upon the future would be as dangerous as unwise. A single decade in this age of electricity overturns more time-honored institutions, and firmly establishes more innovations than a century could have sufficed for in ages past. What even a few years may bring forth no man can say, but the present status and immediate prospects of the copper industry may be set forth as follows:

The production and consumption of copper increased fifty-fold in the Nineteenth century. The demand for the metal was never so great as during the year just closed, and the future prospects of the metal were never so bright as just now. Disregarding the temporary ebb and flow of prices, common to all commodities, the electrification of the world will tax the productive capacity of the copper mines for many years to come. There will be seasons when demand will follow so closely upon the heels of supply that prices will go skyward, and the fool will say in his heart that the market must forever advance. There will also be periods when the supply will far exceed demand, and the faint of heart will say that copper mining is overdone, and never more can be profitable, but in the aggregate the great law of averages, immutable as the law of gravitation, will give to the world the copper for its imperative requirements, at prices not prohibitory to the consumer, yet sufficiently high to provide for the well-managed mines profits beyond the dreams of avarice.

The beginning of the year 1903 finds the United States far in the lead among the copper producing nations of the world, with no prospect that this lead will be lost. The Lake Superior mines will make far more copper this year than ever before. The Montana mines are so entangled in litigation that predictions are hazardous. What they could do, if unhampered, would be to make more copper than ever before. What they will do, no man knows, for mining and litigation are poor bedfellows, and mining suffers by the contact. Arizona continues gaining ground, and will again score great gains in the year now beginning. California should show a gain, also Utah. Wyoming has important copper deposits and the other western states are doing more or less copper prospecting and developing. In the southeast, the Appalachian mines of Tennessee, Virginia and North Carolina are increasing their output and are quite certain to become important factors in American copper production.

Canada is developing copper mines at many points, from the Atlantic to the Pacific, and showing largely increased production. Newfoundland is merely holding its own.

Mexico is certain to rank immediately after the United States in copper production, either this year or next, passing Spain and Portugal, which have long held second place jointly. Mexico's wealth in copper is almost fabulous, and copper is destined to play no small part in the upbuilding of this rapidly growing country.

In South America, Chile, which led the world in copper production twenty years ago, is again gaining ground. Peru is showing a very rapid increase. Bolivia lacks rail communication, capital and machinery; but with these supplied she can greatly increase production. Argentina has good copper properties, but time and money are needed to make them into big mines.

In Europe there is no marked change. Spain and Portugal are producing at a remarkably uniform rate. Germany gains slowly. Norway shows gains and Italy should also increase her output. Austria-Hungary, Turkey and the Balkan states show little change, and small prospects of change in the near future. Russia has excellent copper deposits and in Siberia there are promising districts, merely scratched, at Semipalatinsk and elsewhere.

In Asia the copper production is insignificant, outside of China and Japan. China's enormous mineral resources will be developed in the present century. The preliminary work is now being done, but the Chinese copper production is small and will remain small for at least several years to come. Japan is working her copper mines with energy and good judgment and should become an increasingly important source of supply for the world.

In Africa the Cape Colony mines are the only important producers, and they are barely holding their own. Promising copper deposits are known to exist at several interior points, and one of these, in Rhodesia, is soon to be developed on a considerable scale.

In Oceanica there are important mines and vast undeveloped possibilities in the states of the Australian commonwealth. Tasmanian mines are not developing as rapidly or as promisingly as has been expected. New Caledonian mines, while small producers, are of considerable promise.

In the brief review of present conditions and prospects for the immediate future, contained in the foregoing paragraphs, details have been omitted, and only the most important fields touched upon at all. For more extended consideration of the various cupriferous districts of the world, readers are referred to later chapters, in which the copper districts of the entire globe are treated of in detail.

# CHAPTER II.

## THE GEOLOGY OF COPPER.

In this chapter no attempt is made to give more than the merest outline of the geological features of special interest, pertaining to copper. Geology is, at best, largely an empirical science. From its very nature it can never be made such an exact science as chemistry and mineralogy have already become. This is said in no carping spirit of criticism against the exponents of scientific geology, for their work is of a highly valuable nature, and if the geological dogmas of the present day contain a greater amount of assumption in proportion to ascertained and demonstrable fact than is found in cognate branches of scientific research, the empirical nature of a considerable part of the geology taught at the beginning of the Twentieth century is due to the inherent difficulties of the subject, rather than to any desire of geologists as a whole to assume more than can be proven. Just as a forest of scaffolding is erected around the walls of a great cathedral, while building is in process, so a false-work of theory is indispensable in geological research. Behind the great mass of temporary timbering the granite walls of truth are rising, slowly but surely, and as they rise, the scaffolding that once was necessary becomes useless, and is discarded.

Rocks are divided into three geological classes, the igneous, sedimentary and metamorphic. The igneous rocks, fused by subterranean fires and ejected in sheets by volcanic action, or oozing forth from cracks in the earth's crust, may be divided into granitic, porphyritic and vitreous forms. The sedimentary rocks were deposited by the action of water, usually on beds of former seas. The detrital material so deposited formed conglomerate, shale, sandstone and limestone strata, and in the case of the three first named, the material for sedimentary beds was necessarily obtained principally from the breaking down of the older igneous rocks. Strata of igneous and sedimentary rocks frequently alternate in the older geological groups. The metamorphic or third class, consists of altered rocks of the igneous and sedimentary forms, in which the phenomena of crystallization and replacement have been brought about subsequent to their deposition.

The Devonian system of the Paleozoic group was long regarded as the home of copper, possibly because of the preponderant importance of Cornwall and Devon as sources of copper supply until the middle of the Nineteenth century. Copper is more widely diffused over the earth in rocks of the Permian series of the Devonian system than in any other series of rocks, and the Permian strata are of very extensive occurrence. The Jura-Trias system of the Mesozoic, or age next younger than the Permian, is also prolific in copper. While the Permian beds show more or less copper in most places where outcropping extensively or carefully developed, the percentage of copper contained is apt to be small, though the aggregate of copper so deposited is past computation, owing to the dissemination of the ores through beds that are of vast area.

While native copper is of very frequent occurrence, and is noted in most cupriferous districts, the virgin metal is usually an alteration product, and of little commercial importance. In the Coro Coro district of Bolivia and the Keweenawan district of Lake Superior, native copper is found in such quantities as to permit of its extraction upon an immense scale. The Bolivian copper is found in two adjoining conglomerates, composed mainly of argillaceous sandstones, and of somewhat uncertain geological age. The Lake Superior copper occurs in conglomerate and amygdaloid beds, probably of the Azoic group, though the exact geological horizon is still a matter of dispute. The native metal is most frequently found in eruptive zones, at the various points where it occurs in very considerable quantities, in the sedimentary rocks, such as conglomerates and sandstones, or in the trappean rocks of igneous origin, and more especially in the metamorphosed traps. As an alteration product, native copper may occur in the altered or oxy-carbonate zone of any copper ore body.

The source from which copper came and the manner of its deposition are largely matters for conjecture, though certain features bearing on these questions are fairly well established. The metal and its ores are in all likelihood of igneous origin, coming to the earth's surface or to its crust with the molten magma forced upward from unknown depths. As to the manner of its deposition in veins or beds, there are many theories, of which those most commonly held may be divided into two classes, the first holding that the metal and its ores were deposited in various rock strata and veins from solutions, while the second set of theories is built upon the primary thesis that copper—and other minerals—were deposited by electro-chemical action from sea water, in which process the remains of living organisms are presumed to have played an important part. Both theses have certain corroborative evidences, and both have weak spots. It is possible that ore deposits have come from both sources. It is certain that the sea holds nearly all metals in solution, but, on the whole, the theory of deposition from subterranean solutions seems the most easily tenable.

The more common metals are found as component parts of many ordinary igneous rocks, though in such small quantities that these rocks cannot be considered as ores of even the lowest grade. It is possible, and indeed probable, in the light of the limited amount of exact knowledge now possessed on this point, that subterranean and slightly carbonated surface waters percolating through the various rock strata, very few of which are impervious to water, leached out certain soluble constituents, and that the minerals, so carried in solution, were deposited, usually in crystallized form, in the brecciated rocks and in the numerous cracks in the crust and upper strata of the earth. Carbonic acid, oxygen and sulphur have been the principal reducing agents, carbonic acid gas in water being a powerful solvent. The action and inter-action of these three prime agents, assisted by other reagents set free by them, have caused complex reactions, many of which have been figured out to theoretical perfection, while not a few supposedly natural reactions have the corroborative evidence afforded by synthetical chemical experiments that have given the reactions first established theoretically. In the case of the rich iron ores of the Lake Superior district, their concentration from leaner ores by purely natural means is no longer open to question, except from the ultra-skeptical.

A third theory, once generally held, but now in disfavor, remains to be noted. This is the idea that electrical action caused the deposition of the metals. While the theory now finds few adherents, I must venture the opinion, at the risk of being considered fossilized, that electrical action has played a most important part in the deposition of many metalliferous beds. There are really but two sciences, one being mathematics, which is abstract and perfectable, while the second is the science of the concrete, embracing all matter and its various manifestations. For convenience, the realm of science, an empire vaster than Alexander swayed or Napoleon planned, has been divided into so-called sciences and groups of sciences, but the boundary lines are merely arbitrary abstractions, and have as little physical existence as the equator or the meridians of longitude. Geology shades imperceptibly into mineralogy, which in turn merges into chemistry, dynamics, optics, and electricity. All sciences are interwoven, and electricity, a manifestation of one of the attributes of matter, is an integral part of every other concrete science, from geology to biology, affecting alike the organic and inorganic kingdoms. It is probable that terrestrial magnetism, percolating waters and precipitation from superincumbent seas all played a part in the formation of ore deposits, operating under chemical, thermo-dynamical and electrical conditions of which we now have merely a slight theoretical knowledge. Mother Nature filled the recesses of her myriad subterranean treasure-houses with the wealth that man now wrests from her by brute strength, and the little craft he has been enabled to acquire in the prolonged struggle.

In connection with the foregoing remarks upon the influence of electricity on mineral deposits, it may be remarked that there are puzzling magnetic earth-currents in the Lake Superior native copper districts, these being especially marked upon Isle Royale, where the variation of the magnetic needle is remarkable. It is to be hoped that these phenomena will be given the careful scientific investigation that their importance warrants, at some not distant date. Shortly after the laying of the first Atlantic cable, Ayers Stockley, still a resident of the Lake Superior district, performed some highly interesting experiments in subterranean telegraphy. His apparatus was home-made, but he succeeded in telegraphing for some miles along one of the magnetic currents traversing the cupriferous strata of Ontonagon county, with the crude but effective instruments of his own devising.

It is still a matter of dispute whether many of the great bodies of chalcopyrite and cupriferous pyrite and pyrrhotite are veins or beds. Recent investigation leads to the belief that many of the deposits formerly called beds are in reality entitled to the appellation of veins.

The great predominance of sulphide ores of copper is a notable fact, 75 per cent. of the world's production of the metal coming from ores of this class. It is probably safe to assume that all, or practically all, copper ores were originally sulphides. Chalcopyrite is generally held to be a product of crystallization from fusion. Eventually the upper portions of these chalcopyrite and bornite ore bodies were altered, in the case of the older deposits, mostly to oxide and carbonate ores. In all likelihood this alteration came about from the action of water. The subterranean waters found in all rock strata at greater or less depth, are not oxydizing, but the surface waters have an affinity for carbonic acid, and, carrying this gas in solution, these surface waters, percolating through the rock strata and veins, attack the sulphide ores, which gradually yield up sulphur and become carbonates and oxides, through chemical reactions induced by carbonic acid. For this reason the permanent water level of a mine usually marks the lowest depth at which oxide and carbonate ores are found, and below this point the ores are nearly always sulphides, with a strong tendencey toward lower percentages of copper and higher percentages of iron, as depth is gained.

As chalcopyrite and bornite (compound sulphides of copper and iron) are overwhelmingly the most common ores of copper, and, below the permanent water level, practically the only copper ores, the alteration of these iron-copper sulphides to oxide and carbonate ores (or sometimes to silicates, or the higher sulphides of copper alone) by the action of percolating surface waters, charged with carbonic acid, necessarily sets free one atom of iron for each atom of copper dissociated from the original chemical union, in which one atom each of copper and iron were united with two atoms of sulphur. The iron also forms carbonates or oxides, most usually the latter, and, in the form of limonite, a hydrated sesquioxide of iron, is carried upward in the waters, and stains the rock above or near the surface of the original deposit of chalcopyrite. The characteristic rusty-iron stain of limonite is a prominent feature of the rock-capping surmounting many of the largest copper ore bodies, and this "gossan" or "iron hat" is a welcome sign of copper values below, in nearly every copper-ore mining district of the world. It is not an invariable sign, however, as it is necessarily lacking in many places, such as at imbedded deposits having no outcrop, and unaltered sulphide ore bodies, also at points where the original capping has been removed by surface erosion or glaciation. The gossan may also be found at many points where copper does not lie beneath, but, as a rule, a capping of gossan is a highly favorable sign in a cupriferous district.

The rich oxide and carbonate ores existing at and near the surface in most copper-bearing districts (except in the native copper fields) may safely be considered alteration products from the chalcopyrite and bornite ores found at greater depths. The silicates, phosphates and other ores are probably alteration products also, as are the higher sulphides of copper in which iron is not present, unless as an impurity. In some districts the unaltered sulphides extend to the surface, but this is the exception rather than the rule. The depths to which the carbonate and oxide ores may extend is dependent upon local conditions, and ranges from a few feet to more than one thousand feet. As a rule, the oxide and carbonate and richer sulphide ores (such as chalcocite) give way to unaltered sulphides of copper and iron at the permanent water level. In cases, not so very common, where the altered ores exist below the water level, it is presumed that the alteration occurred during some antecedent age or ages, when the water level was lower, or the rock strata higher. The native copper deposits remain absolutely unaltered in nature or quantity below the water level, which apparently has no effect upon deposits of the virgin metal.

In this place, it may not be amiss to insert a few words of warning and advice to those lacking extended experience in copper mining.. It is undoubtedly true that a geologist of high scientific attainments may make a poor fist at practical mining. Possibly this rule may be considered proven by the brilliant exception recently made by Dr. L. L. Hubbard, who stepped direct from the position of state geologist of Michigan to the general management of a corporation owning undeveloped lands, and within a few months opened what must become one of the greatest copper mines of the world within the next few years. On the other hand, the practical miner to whom is entrusted the development of a new copper mine, may profit greatly by bearing in mind a few facts that are not only geological maxims, but proven by innumerable practical illustrations. It is certain that copper mines—always excepting those producing the native metal—are subject to greater changes with depth than mines of any other class. All mines vary more or less, in width of productive openings and in the values found therein, as depth is gained, but copper ore mines, while varying in width and values with depth just like mines of other metals, are subject to a special series of variations, an understanding of which is of prime importance to owners and managers. In strong veins, where iron-copper sulphides are first encountered, a continuance of the vein to a considerable depth, with comparatively slight alteration, may reasonably be looked for. This does not apply to gash veins, of course, as these are invariably shallow, but the experienced miner is not likely to long mistake a gash vein for a true fissure. In other cases, where the surface openings show rich oxides and carbonates, or chrysocolla and similar ores, it should always be borne in mind that these ores cannot prove permanent. They may extend downward for a few score feet only, or possibly may hold for many hundreds of feet, but sooner or later they will give way at depth to unaltered iron-copper sulphides, as will copper glance or other high-grade ores. The oxides and carbonates, from their richness in metal and the ease with which they may be smelted, are highly desirable ores, and have been the making of many good mines that otherwise would have proven failures, through affording profits with which to open more extensive bodies of lower grade ore at greater depth, and to build and equip the large and costly smelters required for successful treatment of the iron-copper sulphides.

For the reason that a change at depth is inevitable, it is highly important that a new copper mine having high-grade surface ores should prove its property before forming a permanent plan of mining, smelting and financial conduct. This can be done in one way only, and that is by probing the ground. The probing may be done by diamond drills, or by sinking shafts. Diamond drilling is a wonderful aid in exploring new territory, but at best it is only a sort of blind-man's-buff. As a preliminary measure diamond drilling is highly commendable, but for a certainty the shaft or tunnel is the thing. Where a mine is already opened on rich copper ores, sinking is the proper course. This will determine the extent of the richer ore bodies and the nature of the unaltered sulphides. At times highly profitable oxides and carbonates are replaced by sulphides of too low grade to work at a profit. More frequently the richer ores are replaced at depth by sulphides that can be profitably worked, provided a sufficiently extensive mechanical and metallurgical equipment is supplied. As a rule, the better a copper mine at surface, the better at depth, but there are such important exceptions that development is the only safe guide.

For the reasons set forth in the foregoing paragraphs, it is important that the management of a copper ore mine have more than a surface knowledge of its property before laying out permanent plans. Handsome profits may be earned from surface and sub-surface ores, but if these be paid out in dividends as quickly as earned, the change in the ore, certain to come at some depth, may leave the company with a depleted treasury to face the problem of raising large sums for development and equipment. Shareholders will pay assessments more readily on a new or developing mine than on one that has been a dividend payer. In connection with the advice contained in the preceding paragraphs, there are sections in the chapter on metallurgy of interest to those lacking experience who may be responsible for the development of new mines. To the experienced mining men I am not offering advice. Such men are always seeking for information to add to their already extensive stocks, but they do not hanker for advice.

The various chapters on the ore deposits of the world will be found to contain a great amount of geological matter of a more specific nature than given in the preceding pages, and geological data of a still more detailed nature will be found in many of the descriptions of mines. In the chapter on chemistry and mineralogy there are detailed descriptions of the physical and chemical characteristics of the metal and its various ores and minerals, of which the principal, from an economical standpoint, are native copper, chalcopyrite, bornite, chalcocite, malachite, azurite, tenorite, cuprite and chrysocolla.

# CHAPTER III.

## CHEMISTRY AND MINERALOGY OF COPPER.

In the following pages will be found a list of the ores and alloys of copper, with brief descriptions, the detail depending somewhat upon the importance or special interest possessed. The native metal itself is included in the list, which also gives the synonyms of the principal copper ores.

No attempt has been made to render this chapter exhaustive, despite its considerable length. Readers desiring further and more detailed knowledge of the various ores, including their optical properties, complete pyrognostics and crystallization, are referred to the standard works on mineralogy. It is believed, however, that the pages appended may prove of some assistance to the general reader interested in the subject of copper, and possibly will interest the scientist as well, because of being the first encyclopædic list of exclusively copper minerals ever published.

Following is a list of the elements with which copper is found chemically united in nature. This list includes 29 of the 77 elements known to science at this writing. Following the name of each element is its chemical symbol and atomic weight, as now figured by the best authorities.

| Element | Symbol | Atomic weight | Element | Symbol | Atomic weight |
|---|---|---|---|---|---|
| Aluminum | Al | 27.1 | Nitrogen | N | 14.04 |
| Antimony | Sb | 120. | Oxygen | O | 16. |
| Arsenic | As | 75. | Phosphorus | P | 31. |
| Bismuth | Bi | 208.3 | Platinum | Pt | 195. |
| Calcium | Ca | 40.1 | Selenium | Se | 79.2 |
| Carbon | C | 12. | Silicon | Si | 28.4 |
| Chlorine | Cl | 35.45 | Silver | Ag | 107.93 |
| Cobalt | Co | 59. | Sulphur | S | 32.06 |
| Copper | Cu | 63.6 | Tellurium | Te | 127.5 |
| Hydrogen | H | 1.01 | Tin | Sn | 119. |
| Iron | Fe | 56. | Tungsten | W | 184. |
| Lead | Pl | 206.9 | Uranium | U | 240. |
| Manganese | Mn | 55. | Vanadium | V | 51.4 |
| Nickel | Ni | 58.7 | Zinc | Zn | 65.4 |
| Niobium | Nb | 93.7 | | | |

The elements with which copper unites most frequently are as follows, in approximate order of frequency and preference: Sulphur, oxygen, carbon, arsenic, antimony, bismuth, silica, chlorine, phosphorus, nitrogen, selenium, wolframium (tungsten), uranium, and vanadium.

The ores of copper (alone or with other metals) may be divided into the following groups·

Antimonides
Arsenates
Arsenides
Arsenites
Carbonates
Chlorides
Molybdates
Niobates
Nitrates
Oxides
Oxychlorides
Phosphates
Selenides
Selenites
Silicates
Sulphoantimonates
Sulphoantimonites
Sulphoarsenates
Sulphoarsenites
Sulphides
Sulphates
Sulphobismuthites
Tellurides
Tungstates
Uranates
Vanadates

An alphabetical list of copper minerals, and alloys, including native copper and synonyms, is appended.

**ADAMITE.** Essentially a hydrous arsenate of zinc, but copper may replace the zinc to extent of from a trace to 23.5% cupric oxide.

**AIKINITE.** $PbCuBiS_3$. Common names: Needle ore, acicular bismuth. Copper 11%, bismuth 36.2%, lead 36%, sulphur 16.8%. Orthorhombic. Crystals embedded; acicular, striated; also massive. Fracture: Uneven. Hardness: 2 to 2.5. Gravity: 6.1 to 6.8. Luster: Metallic. Color: Blackish lead gray, tarnishing to pale copper red. Opaque. Fuses on charcoal. Soluble in nitric acid. Occurrence: Ural Mountains of Russia, and Gold Hill, North Carolina, U. S. A.

**ALASKAITE.** An argentiferous galena-bismuthite in which lead is partially replaced by silver, 3.25% to 8.75%, and copper 3.5% to 5.1%, with traces of zinc, antimony and iron.

**ALGODONITE.** $Cu_6As$. Copper 83.5%, arsenic 16.5%. Occurrence: Chile and Lake Superior.

**ALISONITE.** A sulphide of lead and copper. Probably $3Cu_2S$, $PbS$.

**ALUMINUM BRONZE.** An alloy of copper and aluminum.

**AMMIOLITE.** Antimonite of copper and mercury. Cupric oxide 15.5% to 18%.

**ANDREWSITE.** A phospho-silicate of copper, iron, manganese and aluminum. About 11% cupric oxide.

**ANNIVITE.** A bismuthiferous stibio-arsenate of copper, carrying about 4% iron and 2% zinc. A complex mineral of the tetrahedrite-tennantite family.

**ANTIMONIAL COPPER.** Chalcostibite.

**ANTLERITE.** A basic sulphate of copper with traces of zinc and calcium; chemical formula uncertain, contains cupric oxide 67% to 68%.

**APHTONITE.** A tetrahedrite carrying silver, iron and zinc.

**ARNIMITE.** $5CuO$, $2SO_3+6H_2O$. Copper 45.5% to 48%.

**ASPEROLITE.** Probably $CuSiO_3$, $3H_2O$. Same as chrysocolle, except in excess of water.

**ATACAMITE.** $Cu_2ClH_3O_3$. Copper 15.9%, cupric oxide 55.8%, chlorine 16.6%, water 12.7%. Cleavage: Imperfect to perfect. Fracture: Conchoidal. Brittle. Hardness: 3 to 3.5. Gravity: 3.75 to 3.77. Luster: Adamantine to vitreous. Color: Emerald to blackish green. Streak: Apple-green. Transparent to translucent. Occurs as sandy granules in the province of Atacama, Chile, where first discovered, also at many other points. A valuable ore of copper where found in commercial quantity.

**ATELITE.** A hydrated cupreous bi-chloride, $2CuO,CuCl_2+3H_2O$. From crater of Vesuvius, apparently at pseudomorphs after tenorite, and nearly the same as atacamite chemically.

**ATLASITE.** A copper chloro-carbonate apparently between atacamite and malachite. From Chanarcillo, Chile.

**AURICHALCITE.** $2(ZnCu)CO_3$, $3(ZnCu)(OH)_2$. A basic carbonate of copper and zinc. Carries about 21% cupric oxide. Monoclinic in acicular crystals, forming drusy incrustations; also columnar, laminated and granular. Hardness: 2. Gravity: 3.5 to 3.6. Luster: Pearly. Color: Pale green to sky blue. Streak: Light green to light blue. Translucent. Soluble in acids. Occurs in small quantities at numerous points.

**AZURITE.** $3CuO,2CO_2,H_2O$. Common names: Blue carbonate of copper, azure copper ore. Monoclinic; also massive to earthy. Cleavage: Perfect, but interrupted. Fracture: Conchoidal. Brittle. Hardness: 3.5 to 4. Gravity: 3.77 to 8.83. Luster: Vitreous. Color: Azure blue. Streak: Lighter blue. Transparent to subtranslucent. Soluble in nitric acid. A fairly common ore of copper.

**BARNHARDTITE.** Apparently a chalcopyrite partly altered to chalcocite, by loss of part of iron content. Assays 47% to 50% copper and 20% to 22.5% iron.

**BAYLDONITE.** A hydrous arsenate of copper and lead, carrying about 26% copper.

**BELL-METAL ORE.** Stannite.

**BERZELIANITE.** A selenide of copper, $Cu_2 Se$. Copper 61.6%. Part of copper replaced with silver at times.

**BEUDANTITE.** A complex and somewhat uncertain arseno-phosphate or phospho-arsenate of iron, copper and lead, with sulphates of the metals present in varying quantities. Contains 8.5% to 12.3% cupric oxide.

**BINNITE.** $3Cu_2S$, $2As_2S_3$. Copper 39.2%. Carries also a little lead, iron and silver.

**BJELKITE.** A cupriferous cosalite.

**BLANCHED COPPER.** An alloy of copper and arsenic.

**BLUESTONE.** Sulphate of copper. Blue vitriol. Chalcanthite.

**BOGOSLOVSKITE.** Apparently an impure chrysocolla, carrying carbon dioxide.

**BOLEITE.** Apparently a variety of percylite carrying chloride of silver. Has 14% to 15% copper, 48% to 51% lead and about 9% to 10% silver. From Boleo mine, Mexico.

**BORNITE.** $Cu_3FeS_3$. Copper 55.5%, Iron 16.4%, sulphur 28.1%. Common name: Peacock copper ore. Isometric; many hexagonal penetration twins. Habit, cubic. Massive. Structure: granular or compact. Fracture: Small conchoidal, uneven. Brittle. Hardness: 3. Gravity: 4.9 to 5.4. Luster: Metallic. Color: Copper red to bluish brown, quickly tarnishing to iridescence. Streak: Pale grayish black. Opaque. Soluble in nitric acid with separation of sulphur. Occurrence: In most of the important copper fields of the world. Uses: The second most important ore of copper.

**BOURNONITE.** $PbCuSbS_3$. Copper 13%, lead 42.5%, antimony 24.7%, sulphur 19.8%. Massive; granular and compact. Crystals, orthorombic. Cleavage: Imperfect. Fracture: Subconchoidal to uneven. Rather brittle. Hardness: 2.5 to 3. Gravity: 5.7 to 5.9. Brilliant metallic luster. Color and Streak: Steel gray, inclining to blackish lead-gray or iron black. Opaque. Fuses easily on charcoal. Decomposed by nitric acid. Occurrence: Hartz Mountains and Saxony, Bohemia, Hungary, Carinthia, Cornwall, Chile, Bolivia, Peru, Canada, Arkansas, Colorado, etc.

**BRASS.** An alloy of copper and zinc, about 2 parts copper to 1 of zinc.

**BROCHANTITE.** A basic sulphate of copper. $4CuO,SO_3,3H_2O$, carrying 70.3% cupric oxide.

**BRONZE** An alloy of copper and tin. The varying proportions give differing colors and qualities, such as bell-metal, medal bronze, gun-metal, etc.

**CACHEUTAITE.** A selenide of lead, copper and silver, with occasional traces of cobalt and iron, carrying 7% to 36% copper.

**CALCIOVOLBORTHITE.** A hydrous vanadate of copper, calcium, magnesium and manganese. Copper 30% to 35%.

**CALIDONITE.** A basic sulphate of lead and copper. Chemical composition uncertain. Cupric oxide about 10%.

**CANTONITE.** A dimorphic variety of covellite crystallized in cubes, with cubical cleavage.

**CAPILLARY RED OXIDE OF COPPER.** Cuprite.

**CARROLLITE.** $CuS,Co_2S_3$. Copper 20.5%, cobalt 38%, sulphur 41.5%. Occurrence: Carroll county, Maryland.

**CASTILLITE.** A bornite of uncertain formula, carrying approximately, copper 41%, zinc 12%, lead 10%, silver 4%, iron 7%.

**CHALCANTHITE.** $CuSO_4+5H_2O$. Common names: Blue vitriol, bluestone, sulphate of copper. Carries about 25% copper. Triclinic. As crystals, also massive, stalactitic and reniform, sometimes with fibrous structure. Luster: Vitreous. Color: Sky blue. Subtransparent to translucent. Soluble in water. Solution will deposit metallic copper on iron.

**CHALCOCITE.** Copper glance. $Cu_2S$. The richest sulphide ore, carrying copper 79.8%, sulphur 20.2%, also frequently iron or silver in small quantities. Orthorhombic: Also massive, with structure granular to compact and impalpable. Cleavage: Indistinct. Fracture: Conchoidal. Somewhat brittle. Hardness: 2.5 to 3. Gravity: 5.5 to 5.8. Luster: Metallic. Color and Streak: Blackish lead-gray, tarnishing to dull green or blue. Opaque. Soluble in nitric acid. Occurrence: In nearly all sulphide copper districts of the world in small quantities, occasionally in considerable bodies. Uses: The richest commercial ore of copper.

**CHALCOPYRITE.** $CuFeS_2$ (or $Cu_2S,Fe_2S_3$). Copper 34.5%, iron 30.5%, sulphur 35%. Frequently mixed with pyrrhotite; occasionally carries gold or silver. Tetragonal; sphenoidal, often twinning; also frequently massive and compact. Fracture: Uneven. Hardness: 3.5 to 4. Gravity: 4.1 to 4.3. Luster: Metallic. Color: Brass yellow, often tarnishing to iridescence. Streak: Greenish black. Opaque. Soluble, except sulphur, in nitric acid. On being heated yields up a portion of its sulphur. On exposure to moisture and heat becomes hydrated, and copper and iron change readily to sulphates. Occurrence: In every copper field of importance. The most common ore of copper, and the source of nearly 75% of the world's supply of the metal.

**CHALCOMENITE.** A hydrous selenite of copper. $CuSeO_3+2H_2O$. Carries about 35% cupric oxide and 48% selenium dioxide.

**CHALCOPHYLLITE.** A highly basic arsenate of copper; formula given variously—simplest is $7CuO,As_2O_5,14H_2O$. Percentage of cupric oxide 44.5% to 53%.

**CHALCOPYRRHOTITE.** $Fe_4CuS_6$. Copper 13%, iron 48%, sulphur 38%. Occurrence: Cuba and Sweden.

**CHALCOSIDERITE.** $CuO, 3Fe_2O_3, 2P_2O_5, 8H_2O$. Cupric oxide about 8%.

**CHALCOSINE.** Chalcocite.

**CHALCOSTIBITE.** $Cu_2S, Sb_2S_3$. Essentially a sulpho-antimonide of copper, carrying about 25% copper, 48% antimony, 26% sulphur, with 1% to 2% iron and occasionally a fractional percentage of lead.

**CHALCOTRICHITE.** A form of cuprite with capillary or acicular crystallization.

**CHENEVIXITE.** A hydrous arsenate of copper and iron, formula uncertain. Cupric oxide about 26.3%.

**CHESSY COPPER.** Azurite.

**CHILENITE.** Probably $Ag_6Bi$, with copper replacing silver to extent of about 7%.

**CHIVIATITE.** A sulphide of lead and bismuth in which lead is partly replaced by copper to extent of about 2.5%. Occurrence: Chiviato, Peru.

**CHLOANTHITE.** Empirically $NiAs_2$, a diarsenide of nickel. In analyses invariably shows cobalt and iron, and frequently traces of copper bismuth, antimony, lead and silver. The ease with which partial replacement of the nickel is effected in both chloanthite and smaltite calls attention to the minerals keweenawite and mohawkite, which, though lower in the series of arsenides, are very properly described by Dr. Koenig, the discoverer, as compound arsenides, the formula being written (CuNiCo). The same formula might be used to advantage with chloanthite, smaltite and sundry other arsenides of protean forms.

**CHLOROTILE.** $Cu_3$, $As_2O_8+6H_2O$. Carries about 32.5% copper. A hydrous arsenate of copper. Orthorhombic; fibrous and massive. Soft. Color: Pale emerald green. Transparent.

**CHRYSOCOLLA.** $CuSiO_3$, $2H_2O$. Carries about 36.1% copper. Common name: Mountain green and Mountain blue. Cryptocrystalline, enamel-like. Sometimes botryoidal. Fracture: Conchoidal. Brittle and somewhat sectile. Hardness: 2 to 4. Gravity: 2 to 2.24. Luster: Vitreous to earthy. Color: Mountain green, bluish green, sky blue to turquoise blue. Impure varieties, brown to dull black. Streak: White from pure varieties. Translucent to opaque. Decomposed by acids without gelatinization. Occurrence: Frequently with other ores, especially in upper portions of veins.

**CLARITE.** Probably a dimorphus form of enargite.

**CLAYITE.** A stibio-arsenate of lead, with lead replaced to extent of about 8% copper and a trace of silver.

**CLINOCLASITE.** $6CuO$, $As_2O_5+3H_2O$. Carries 48% to 50% copper. A hydrous arsenate of copper. Cleavage: Highly perfect. Brittle. Hardness: 2.5 to 3. Gravity: 4.19 to 4.36. Luster: Vitreous to resinous. Color and Streak: Bluish-green. Subtransparent to translucent. Soluble in nitric acid. Occurrence: Cornwall and Utah.

**CONDURRITE.** A soft, black copper ore, found in Cornwall; supposed to be an alteration product of tennantite.

**CONICHALCITE.** An arsenate of copper and calcium, carrying occasionally zinc and vanadium. Cupric oxide about 28% to 32%.

**CONNELLITE.** A hydrous sulpho-chlorate of copper, carrying 72.3% cupric oxide.

**COPPER.** Cu. Native copper. The chemical symbol Cu is an abbreviation of cuprum, the Latin word for copper. The metal, native or refined, has the following names in the modern languages: kupfer in German; kopper in Swedish; kobber in Norwegian; cobre in Spanish and Portuguese; cuivre in French; rame in Italian.

Atomic weight, 63.6. Belongs in the first group and is the leader of the fifth series of Mendeleef's Periodic System. The group is as follows: 1. hydrogen; 2. lithium; 3. sodium; 4. potassium; 5. copper; 6. rubidium; 7. silver; 8. caesium; 9. unknown (possibly terbium, atomic weight 160); 10. gold; 11. unknown. The fifth series, of which copper is the basic leader, is as follows: 1, copper; 2, zinc; 3, gallium; 4, germanium; 5, arsenic; 6, selenium; 7, bromine. The three metallic elements falling between series four and five in Mendeleef's table, are iron, cobalt and nickel. The frequency with which these three elements are found associated with copper, and the ease with which all four metals replace one another are notable. The general resemblance between copper, silver and gold, which form ascending steps in the same group, is readily apparent. Mendeleef's Periodic System may not prove the key to unlock the chemical secrets of nature, but it may be compared to a single tumbler in a combination lock, which has been nearly set in its proper position for opening.

System of crystallization, isometric. Tetrahexahedronal forms the most common, with much twinning. Crystals often show cavernous faces and occasionally elevations. Crystals are often distorted and pass gradually through distortions into filiform and arborescent forms. Druses, often of considerable size, in Lake Superior native copper mines, notably the Central and Phœnix mines in Keweenaw county, afford many curious crystallizations, filiform and arborescent. Native copper also occurs massive, and in granular form, and in laminæ. In the Lake Superior mines the metal occurs in all observed forms and sizes; in lamellar form, from microscopic flakes up to sheets of immense size and weight; in crystals of greatly varying form and size; in grains from microscopic size to considerable nodules, and in the various filiform and arborescent shapes in druses. The finest particles are grains and exceedingly minute flakes occurring in an upper sandstone of the Keweenawan series, while the largest masses, weighing upwards of 500 tons, have been found in contact and fissure veins in Keweenaw and Ontonagon counties, though the bulk of the copper produced is secured from the stratified igneous and sedimentary beds of the Keweenawan series.

Cleavage: None. Fracture: Hackly. Tenacity: Second only to that of iron. Perfectly sectile. Highly ductile and malleable, ranking in these particulars with the precious metals. Electrical conductivity, 931, as compared with 1,000 for silver, which possesses the most perfect electrical conductivity of any known metal or alloy. Conductivity for heat, 898, as compared with 1,000 for gold, the most perfect conductor of heat.

Hardness: 2.5 to 3. Specific gravity, in vacuo, at 0 degrees Centigrade (equal to 32°, or freezing point Fahrenheit), when chemically pure and devoid of porosity, is 8.945. Specific gravity of ordinary copper of commerce, none of which is free from impurities, varies from about 8.75 when cast to about 8.95 when rolled, hammered or drawn, the exact gravity depending upon how handled and extent and nature of impurities present.

Luster: Metallic. Color: Copper-red. Streak: Copper-red, metallic, shining. Tarnishes upon exposure of air to brownish red, and is liable to form a coating of verdigris or oxide upon long exposure to air. Atmosphere laden with moisture and carbonic acid is especially favorable for the formation of verdigris.

Fusibility: Copper is fusible at approximately 2,000° Fahrenheit, or a trifle less than 1,100° Centigrade. Color, when fused, sea-green. Copper becomes volatile under the high temperature of the electric arc.

Solubility: Copper is soluble in nitric acid, aqua regia, and strong boiling sulphuric acid, also, slowly, in dilute hydrochloric and sulphuric acids, with admission of air. When in solution in nitric acid will deposit metallic copper on iron immersed therein.

Affinities: Copper has a greater affinity for sulphur than for any other element. Also possesses marked affinities for arsenic, antimony, bismuth, oxygen and carbon dioxide, and unites with many other elements.

Alterations: Native copper alters on exposure, especially in damp air, to the simpler oxide and carbonate ores, such as cuprite, malachite and azurite, and occasionally, in time, to the more complex ore forms.

Occurrence: Native copper occurs, usually in small quantities, in most of the principal copper-ore producing districts of the world. The native metal is mined upon a considerable scale only in Bolivia and Lake Superior, U. S. A. The Lake Superior district is notable for producing copper from deposits of the native metal almost exclusively. The Lake Superior native copper carries considerable silver, but no gold. In districts outside of Lake Superior and Bolivia the metal occurs most frequently in connection with the oxide and carbonate ores, and occasionally with the more common sulphide ores.

Impurities: The native copper frequently contains silver, arsenic, bismuth, antimony, zinc, iron and mercury. Commercial copper, refined from ores, may contain any of the elements already named, and also gold, lead, selenium and tellurium, the latter two elements in very minute quantities.

**COPPER GLANCE.** Chalcocite.

**COPPER NICKEL.** Niccolite.

**COPPER PITCHBLENDE.** A ferruginous chrysocolla.

**COPPITE.** A tetrahedrite carrying about 13% of iron.

**CORNWALLITE.** $5CuO, As_2O_5, 3H_2O$. Cupric oxide 58.2%.

**COSALITE.** A sulphide of lead and bismuth in which lead is frequently displaced by copper to the extent of 1% to 9% and silver 1% to 16%.

**COVELLINE.** Covellite.

**COVELLITE.** Cupric sulphide. CuS. Copper 66.4%. An alteration product from chalcocite and other sulphide copper ores.

**CREDNERITE.** $Cu_3Mn_4O_9$. Cupric oxide 43%, manganese sesquioxide 57%. Monoclinic; foliated crystalline. Cleavage: Basal, very perfect; less distinct in other directions. Hardness: 4.5. Gravity: 4.9 to 5.1. Luster: Metallic. Color: Iron black to steel gray. Streak: Brownish-black. Soluble in hydrochloric acid.

**CROOKESITE.** A selenide of copper, silver and thallium, $(Cu, Tl, Ag)_2Se$, carrying 44% to 46.5% copper, 1.5% to 5% silver and 16% to 18.5% thallium.

**CUBANITE.** $CuFe_2S_4$. Copper 23.3%, iron 41.3%, sulphur 35.3%. Also carries silica, and sometimes small percentages of lead and zinc.

**CUPRIC OXIDE.** $CuO$. Monoxide of copper. One atom of copper and one of oxygen, chemically united.

**CUPRITE.** $Cu_2O$. Copper 88.8%, oxygen 11.2%. Common names: Octahedral copper ore; red glassy copper ore; ruby copper. Isometric; commonly in octahedrons; also massive, granular; sometimes earthy. Cleavage: Interrupted. Fracture: Conchoidal. Brittle. Hardness: 3.5 to 4. Gravity: 5.85 to 6:15. Luster: Adamantine to earthy. Color: Light to dark red. Streak: Shining brownish red. Subtransparent to subtranslucent. Soluble in concentrated hydrochloric acid. Found in most copper districts, especially near surface.

**CUPROBISMUTITE.** Essentially $3Cu_2S, 4Bi_2S_3$, in which silver sometimes partly replaces the copper. Carries 7% to 16% copper, with slight amounts of silver and iron, and occasionally lead.

**CUPRODESCLOIZITE.** A complex hydrous arseno-phospho-vanadate of lead, zinc, copper, iron and manganese. Cupric oxide from 6.75% to 11.21%.

**CUPROPLUMBITE.** A sulphide of lead and copper; probably $Cu_2S,PbS$. Carries about 20% copper. From Chile.

**CUPROSCHEELITE.** A tungstate of copper and calcium, carrying silica. Has 3% to 7% cupric oxide.

**CUPROTUNGSTITE.** Tungstate of copper. $CuWO_4$. Carries about 30% cupric oxide.

**CUPROUS OXIDE.** $Cu_2O$. Two atoms of copper chemically united with one atom of oxygen.

**CYANOCHALCITE.** A phosphoriferous chrysocolla.

**CYANOCHROITE.** $CuSo_4, K_2So_4+6H_2O$. Hydrous sulphate of copper and potash. Carries about 18% cupric oxide.

**CYANOTRICHITE.** Formula perhaps $4CuO,Al_2O_3,So_3+H_2O$. A hydrous basic sulphate of copper and aluminum. Cupric oxide 47% to 50%.

**DARWINITE.** Whitneyite.

**DELAFOSSITE.** An oxide of iron, copper and aluminum, carrying about 47.5% monoxide of copper.

**DEMIDOVITE.** A phosphoriferous chrysocolla.

**DIHYDRITE.** $5CuO, P_2O_5+2H_2O$. Carries about 55% copper. Monoclinic; massive; fibrous. Cleavage: Imperfect. Fracture: Conchoidal to uneven. Brittle. Hardness: 4.5 to 5. Gravity: 4 to 4.4. Luster: Adamantine. Color: Dark emerald green. Streak: Pale emerald green. Translucent. Soluble in nitric acid. Occurrence: Germany and the Urals.

**DIOPTASE.** $H_2CuSiO_3$ or $(CuO, SiO_2, H_2O)$. Cupric oxide 50.4%, silica 38.2%, water 11.4%. Common names: Emerald copper; emerald malachite. Rhombohedral; tetartohedral; also massive. Cleavage: Perfect. Fracture: Conchoidal to uneven. Brittle. Hardness: 5. Gravity: 3.28 to 3.35. Luster: Vitreous. Color: Emerald green. Streak: Green. Transparent to subtranslucent. Fusible with charcoal and soda. Gelatinizes with hydrochloric acid. Occurrence: Siberia, Hungary, Arizona, etc.

**DOGNACSKAITE.** A sulphide of bismuth and copper, carrying about 12% copper. From Hungary.

**DOLEROPHANITE.** A basic sulphate of copper, probably $2CuO, SO_3$, with 62.27% to 65.2% cupric oxide. A sublimation product from the laboratory of Vesuvius.

**DOMEYKITE.** $Cu_3As$. Common name: Arsenical copper. Carries 71.7% copper, 28.3% arsenic. Reniform and botryoidal; also massive. Fracture: Uneven. Hardness: 3 to 3.5. Gravity: 7.2 to 7.75. Luster: Metallic. Color: Tin white to steel gray, with iridescent tarnish. Occurrence: Lake Superior, Chile, Mexico and Saxony.

**EHLITE.** $5CuO, P_2O_5+3H_2O$. Carries about 53% copper. Closely related chemically and in physical characteristics to pseudomalachite and dihydrite.

**EMERALD COPPER.** Dioptase.

**EMPLECTITE.** $Cu_2S, Bi_2S_3$. Carries bismuth 62%, copper 19%, sulphur 19%, with occasional silver, iron, lead, and silica, also traces of tellurium.

**ENARGITE.** $Cu_3As_4$. Copper 48.3%, arsenic 19.1%, sulphur 32.6%. Orthorhombic. Small crystals, also massive; granular and columnar. Cleavage: Perfect to indistinct. Fracture: Uneven. Brittle. Hardness: 3. Gravity: 4.45. Luster: Metallic. Color and Streak: Grayish black to iron black. Opaque. Fuses on charcoal. Soluble in aqua regia. Occurrence: South America, Mexico, Luzon in the Phillipine Islands, also several American states.

**EPIGENITE.** Chemical formula uncertain. A sulpho-arsenide of copper and iron. Constituents by weight, about: Copper 41%, iron 15%, arsenic 12%, sulphur 32%. Orthorhombic. In short prisms, resembling arsenopyrite. Fracture: Uneven. Hardness: 3.5. Luster: Metallic. Color: Steel gray. Streak: Black. Soluble in nitric acid. Occurrence: Wittichen in Baden, Germany.

**ERINITE.** $5CuO, As_2O_5, 2H_2O$. Carries about 47.8% copper. Mamillated concentric crystalline groups; fibrous and rough. Brittle. Hardness: 4.5 to 5. Gravity: 4.04. Luster: Slightly resinous. Color: Emerald green. Streak: Grass green. Subtranslucent to opaque. Soluble in nitric acid. Occurrence: Cornwall and Utah.

**ERUBESCITE.** Bornite.

**ERYTHROCALCITE.** $CuCl_2+2H_2O$. Deliquesces on exposure. From crater of Vesuvius.

**EUCAIRITE.** A selenide of copper and silver. $Cu_2Se$, $Ag_2Se$. Copper 25.3%, silver 43.1%, selenium 31.6%.

**EUCHROITE.** A complex hydrous arsenate of copper, carrying 47.1% cupric oxide.

**FAHLERZ.** Tetrahedrite. Gray copper ore.

**FAHLORE.** Tetrahedrite.

**FAMATINITE.** $Cu_3SbS_4$, arsenic occasionally replacing the antimony. Copper 43.3%, antimony 27.4%, sulphur 29.3%. Orthorhombic; Isomorphous with enargite; also massive. Fracture: Uneven. Brittle. Hardness: 3.5. Gravity: 4.57. Gray with copper-red tinge. Streak: Black. Opaque. Fusible on charcoal. Decrepitates in closed tube. Occurrence: Cerro de Pasco, Peru.

**FIELDITE.** A stibio-arsenate of copper, having about 37% copper, 7% zinc, 1.2% iron and traces of gold and silver.

**FOOTEITE.** Formula probably $8Cu(OH)_2$, $CuCl_2+4H_2O$. A hydrous chloride of copper.

**FOURNETITE.** Probably a mechanical admixture of galena and tetrahedrite.

**FREDERICITE.** A tennantite carrying about 6% iron, 3.4% tin, 2.9% silver and 3.4% lead.

**FREIBERGITE.** A tetrahedrite carrying 26% to 31% silver, as well as small quantities of iron and zinc.

**FRIGIDITE.** A tetrahedrite carrying about 8% nickel and 13% iron.

**GERHARDTITE.** A basic cupric nitrate. $4CuO$, $N_2O_5$, $3H_2O$. Contains 66.2% cupric oxide, 22.5% nitrogen pentoxide, and 11.3% water.

**GERMAN SILVER.** An alloy of about 5 parts copper, 2 parts zinc and one part nickel.

**GLASBACHITE.** Zorgite.

**GRUENAUITE.** A supposedly impure polydimite (nickel sulphide) carrying 11.5% copper, also bismuth, iron, cobalt and lead.

**GUEJARITE.** $Cu_2S$, $2Sb_2S_3$. Carries about 15.5% copper, 58.5% antimony and 25% sulphur. From Andalusia, Spain, found with siderite.

**HENWOODITE.** A phospho-arsenate of copper, with occasional aluminum and iron. About 7% cupric oxide.

**HERMESITE.** A tetrahedrite carrying mercury.

**HERRENGRUNDITE.** $CaO, 4CuO, 2SO_3+6H_2O$. Carries 50% to 54% cupric oxide.

**HOMICHLINITE.** Apparently a chalcopyrite partly altered to bornite. Carries about 44% copper and 26% iron.

**HORSFORDITE.** An antimonide of copper, probably $Cu_6Sb$. Carries about 73% copper, 27% antimony. Massive. Fracture: Uneven. Brittle. Hardness: 4 to 5. Gravity: 8.8. Luster: Metallic. Color: Silver white, tarnishing easily. Opaque. Occurrence: In large deposits near Mitylene, Asia Minor.

**HYDROCIANITE.** Cupric sulphate. $CuSO_4$. A rare sulphate from Vesuvius. Effloresces in the air.

**INDIGO COPPER.** Covellite.

**JALPAITE.** Probably $3Ag_2S$, $Cu_2S$, giving about 13% copper.

**JOHANNITE.** A hydrous sulphate of uranium and copper, of uncertain formula, carrying about 6% cupric oxide, and 67% to 68% uranic trioxide.

**JULIANITE.** A tetrahedrite-tennantite carrying less than 1% each of silver and iron, with about 52% of copper.

**KEWEENAWITE.** $(CuNiCo)_2As$. Carries 39% to 54% copper, 9.7% to 20% nickel, 0.9% cobalt. An arsenide of copper, nickel and cobalt, of the mohawkite family. No crystals are known. Cleavage: Subconchoidal. Fracture: Uneven. Tenacity: Slight. Hardness: 4. Gravity: 7.7. Luster: Metallic. Opaque. Color: Pale red, tarnishing to darker red. Soluble in nitric acid. Occurrence: In the Mohawk mine, Keweenaw county, Michigan. Uses: Is smelted, in conjunction with mohawkite.

**KLAPROTHOLITE.** $3Cu_2S$, $2Bi_2S_3$. Carries 24% to 29% copper and 51.5% to 54% bismuth with 1% to 1.7% iron.

**KROEHNKITE.** $CuSo_4$, $NaSo_4+,2H_2O$. A hydrous sulphate of copper and sodium. Carries about 47% cupric oxide.

**LANGITE.** A basic sulphate of copper. $4CuO$, $SO_3$, $4H_2O$. Carries about 17% cupric oxide.

**LAMPADITE.** Cupreous manganese containing 4% to 18% cupric oxide.

**LAVENDULAN.** A hydrous arsenate of copper, cobalt and nickel. Constituents by weight: About 32% copper, 2.5% CoO, 1.35% NiO. Amorphous. Fracture: Conchoidal. Hardness: 2.5 to 3. Gravity: 3.01. Luster: Greasy to vitreous. Color: Lavender blue. Streak: Pale lavender blue. Translucent. Soluble in warm hydrochloric acid. Occurrence: Saxony and Chile.

**LAXMANNITE.** Phosphochromite.

**LEPIDOPHARITE.** A cupreous manganese oxide of fibrous and scaly form, from Thuringia.

**LETTSOMITE.** Cyanotrichite.

**LEUCOCHALCITE.** A hydrous arsenate of copper. In slender needle crystals. Color: Greenish white. Cupric oxide 47.2%.

**LIBETHENITE.** $4CuO$, $P_2O_5$, $H_2O$. Carries about 53% copper. Common name: Phosphate of copper. Orthorhombic. Fracture: Subconchoidal to uneven. Brittle. Hardness: 4. Gravity: 3.6 to 3.8. Luster: Resinous. Color and Streak: Olive green. Subtranslucent. Soluble in nitric acid. Occurrence: Hungary, Germany, Russia, Bolivia, Chile, Cornwall.

**LIME-MALACHITE.** A hydrous carbonate of copper with carbonate and sulphate of calcium.

**LINARITE.** A basic sulphate of copper and lead, $PbO$, $CuO$, $SO_3$, $H_2O$. contains about 17% to 20% cupric oxide.

**LINDACKERITE.** A complex hydrous sulpho-arsenate of copper, nickel and iron; cupric oxide 36.34%, nickel monoxide 16.15%.

**LINNAEITE.** A sulphide of cobalt in which cobalt is sometimes partially replaced by nickel, copper and iron, to extent of 1% to 42% nickel, 2% to 6% iron and 1% to 8% copper.

**LIRCONITE.** Octahedral arsenate of copper. Probably $18CuO$, $4Al_2O_3$ $5As_2O_5+55H_2O$. Carries about 28.5% copper. Monoclinic; rarely granular. Cleavage: Subconchoidal. Imperfectly sectile. Hardness: 2 to 2.5. Gravity: 2.88 to 2.98. Luster: Vitreous. Color and Streak: Sky blue to verdigris green. Soluble in nitric acid. Occurrence: Cornwall and Hungary.

**LUZONITE.** Apparently a dimorphous form of enargite, found in the island of Luzon, P. I.

**LYELLITE.** An impure variety of langite, containing gypsum and iron.

**MALACHITE.** $2CuO$, $CO_2+2H_2O$. Green carbonate of copper, the most common carbonate. Monoclinic; acicular of prisms. Commonly massive or frequently incrustive. Sometimes granular or earthy. Fracture: Subconchoidal, uneven. Brittle. Hardness: 3.5 to 4. Gravity: 3.9 to 4.03. Luster of crystals, adamantine to vitreous. Color: Bright green. Streak: Green. Opaque to translucent. Soluble in nitric acid. Occurrence: In most copper districts. Uses: An important ore of copper in certain districts.

**MALINOWSKITE.** A tetrahedrite carrying 13% to 16% lead, also silver and zinc in small percentages.

**MARCYLITE.** An alteration product of copper sulphide, consisting of hydrated oxides and sulphides of copper. Found in Arkansas, U. S. A., and Peru.

**MATTRAMITE.** A vanadate of lead and copper sometimes carrying also iron, zinc, manganese, magnesium and calcium oxides. From 19% to 21% cupric oxide.

**MELACONITE.** Tenorite.

**MELANOCHALCITE.** Form: Amorphous or cryptocrystalline. Color: Jet black, coffee brown powder. Luster: Vitreous. Hardness: 4. Specific gravity: 4.14. Opacity: The fine particles are translucent under high power of microscope, light passing through as yellow-brown. Chemical characters: Heated in a closed tube loses water and carbon dioxide and powder turns from coffee brown to brown black. With borax gives the sky blue color of copper. With salt of phosphorus gives a skeleton of silica in the blue glass. Is decomposed by hydrochloric acid, even a 3% solution of acid changing a fragment into a white silicious mass retaining the outlines of the original fragment, and only cupric chloride being produced. Composition: $CuO$, 76.88; $SiO_2$, 7.80; $CO_2$, 7.17; $H_2O$, 7.71; $MO$, .41; $FeO_3$,.07.

$SiO_2$ and $CO_2$ replace each other within certain limits. From this fact and the behavior of the mineral under dilute hydrochloric acid, it is deduced by Dr. Geo. A. Koenig, who identified the mineral, late in 1902, that there exists in it a compound orthoacid, $H_4(Si,C)O_4$, with the hydrogen replaced by copper. Viewed in this light melanochalcite represents the basic copper salt of the ortho-silico-carbonic acid, the figures of the analysis agreeing closely with the formula $Cu_2(Si,C)O_4,Cu(HO)_2$. Occurrence: In the Calumet & Arizona mine, Bisbee, Arizona, the mineral always surrounding cuprite as a black band and being overlaid in turn by green copper silicate and copper carbonate.

**MILANTERITE.** $(FeCu)SO_4+7H_2O$. A sulphate of iron and copper, in which the latter has partly replaced the iron. Carries 10% to 16% cupric oxide.

**MIXITE.** A hydrous basic arsenate of copper and bismuth, of doubtful formula. Carries about 44% cupric oxide.

**MOHAWKITE.** $(CuNiCo)_3As$. An arsenide of copper, nickel and cobalt. No natural crystals have been found, but artificial crystals, hexagonal, have been produced by synthesis by Dr. G. A. Koenig, the discoverer of mohawkite. Constituents by weight: Copper, 63% to 69%; nickel, 3% to 7%; cobalt, 0.5% to 2%; arsenic, about 28%, with more or less silver replacing copper. Cleavage: Indistinct. Fracture: Uneven. Tenacity: Slight. Hardness: 4. Gravity: 8.05. Color: Gray on fresh fractures, tarnishing to purple or brassy yellow. Streak: Gray. Opaque. Soluble in nitric acid. Occurrence: In a fissure vein, in considerable quantities, at the Mohawk mine, Keweenaw county, Michigan.

**MOHAWK-WHITNEYITE.** $Cu_9As$. Carries 83% to 87% copper. Is a mere name of convenience for an intimate blending of mohawkite and whitneyite, or keweenawite and whitneyite, rather than the name of a distinct mineral. Blending is indistinguishable to the eye, but is determined chemically. Malleable; only a little less so than copper. Cleavage: None. Fracture: Hackly. Hardness: About 5. Gravity: 8.6. Color: Gray, with yellow tinge, tarnishing to coffee brown. Streak: Gray. Opaque. Soluble in nitric acid with small residue of gray powder. Occurrence: At Mohawk mine, Keweenaw county, Michigan.

**MOUNTAIN BLUE.** Azurite.

**MOUNTAIN GREEN.** Malachite.

**MYSORIN.** An impure malachite from Mysore, India.

**NAMAQUALITE.** A hydrated oxide of copper, aluminum, manganese, calcium and silicon, with 44.75% cupric oxide. From Namaqualand, South Africa.

**NANTOKITE.** CuCl. A simple chloride of copper. Copper 84.1%, chlorine 35.9%. Isometric; granular; massive. Cleavage: Cubic. Fracture: Conchoidal. Hardness: 2 to 2.5. Gravity: 3.9. Luster: Adamantine. Colorless to grayish white. Transparent to translucent. Soluble in nitric or hydrochloric acids and in ammonia. Gives off chlorine when struck a sharp blow. Oxydises readily on exposure to atmosphere. Occurrence: Carmen Bajo mine, Chile.

**NOHLITE.** A frightfully complex niobate of zirconium, uranium, yttrium, erbium, cerium, iron, calcium, manganese and copper; latter less than 1%. From a feldspar quarry in Nohl, Sweden.

**OCTAHEDRAL COPPER ORE.** Cuprite.

**OLIVENITE.** $4CuO, As_2O_5, H_2O$. Carries about 44.8% copper. Common name: Olive green copper ore. Orthorhombic; crystals prismatic, acicular; also globular and granular. Fracture: Conchoidal to uneven. Brittle. Hardness: 3. Gravity: 4.1 to 4.4. Luster: Adamantine to vitreous. Color: Olive green to blackish green. Subtransparent to opaque. Soluble in nitric acid.

**ORILEYITE.** Probably $(Cu_2Fe)_3(As, Sb)_2$. A stibio-domeykite in which iron has partly replaced copper; found in Burmah.

**PARAMELACONITE.** Apparently a duplex oxide of copper, assaying about 85% cuprous oxide and 13% cupric oxide.

**PEACOCK ORE.** Bornite. Name sometimes applied to chalcopyrites showing iridescent tarnish.

**PELOCONITE.** A variety of cupreous manganese.

**PENTLANDITE.** A sulphide of iron and nickel, carrying varying amounts of copper in small percentages.

**PERCYLITE.** Chemical formula probably $PbCuO_2H_2Cl_2$. Copper about 17%. Hardness: 2.5. Color and Streak: Sky blue. Occurrence: South Africa, Mexico, Chile, Bolivia.

**PHILLIPITE.** Formula approximately $CuSo_4, Fe_2(SO_4)_3 + O?H_2O$. A hydrous sulphate of copper and iron.

**PHILLIPSITE.** Bornite.

**PHOSPHOCHROMITE.** A phospho-chromate of copper and lead, containing 4.57% to 7.36% cupric oxide.

**PILLARITE.** An aluminous chrysocolla.

**PIRITAS FERROCOBRIZAS.** Spanish for iron-copper sulphides.

**PISANITE.** $(Fe, Cu)SO_4 + 7H_2O$. An iron sulphate in which part of the iron has been replaced by copper.

**PLUMBOCUPRITE.** Cuproplumbite.

**PLUSH COPPER.** Cuprite.

**POLYBASITE.** A sulphide of silver and antimony in which copper replaces part of the silver.

**PRASINE.** A varietal form of ehlite, carrying arsenic, silica and alumina.

**PSEUDOLIBETHENITE.** A hydrous libethenite.

**PSEUDOMALACHITE.** $6CuO,P_2O_5+3H_2O$. Carries about 56.5% copper, 21.2% phosphorous pentoxide. Color: Dark emerald green. Greatly resembles dihydrite in chemical composition and characteristics.

**PSITTACINITE.** A phospho-arseno-vanadate of lead, copper, zinc and iron, with occasional cobalt. About 16% to 18% cupric oxide.

**PURPLE COPPER ORE.** Bornite.

**RABDIONITE.** A hydrated oxide of iron, manganese, aluminum, copper and cobalt, with about 14% of cupric oxide.

**RED GLASSY COPPER ORE.** Cuprite.

**REDRUTHITE.** Chalcocite.

**REGNOLITE.** $Cu_7As_2S_{12}$. About 33% copper, also silver, iron, zinc and trace of lead. Tetrahedral crystals. Associated with sandbergerite, which it greatly resembles. Occurrence: Cajamarca, Peru.

**REZBANYITE.** Cupriferous cosalite. A sulphide of lead and bismuth, carrying 1.5% to 4% cupric oxide, with some silver and a trace of zinc. Occurrence: Rezbanya, Hungary.

**RIONITE.** A varietal form of tennantite, carrying antimony, bismuth, iron, silver and cobalt.

**RUBY-COPPER.** Cuprite.

**RICKARDITE.** A telluride of copper. $Cu_4$, $Te_3$. Probably one molecule of cuprous telluride and two molecules of cupric telluride, $Cu_2Te$ $2CuTe$. Constituents by weight: Copper, 40.51%; tellurium, 59.49%. Massive. Fracture: Irregular. Hardness: About 3.5. Gravity: 7.54. Color: Brilliant purple, rivalling bornite tarnish, even on a fresh fracture, and showing deep color when pulverized. Fusible: On charcoal. Soluble: In nitric acid. Occurrence: Good Hope mine, Vulcan, Colo., in vein of pyrite carrying native sulphur and native tellurium, rickardite occurring as lense-shaped masses rather intimately associated with masses of native tellurium, latter being of unusual size, sometimes nearly 3 inches. Identified late in 1902 by W. E. Ford. Is the first telluride of copper discovered, and shows an interesting resemblance to the selenide of copper.

**SANDBERGERITE.** A tennantite-tetrahedrite carrying about 2.4% iron, 7% to 8% zinc and 3% lead.

**SCHWARTZITE.** A tetrahedrite carrying 15% to 17% mercury, with small percentages of iron and zinc.

**SERPIERITE.** A basic hydrous sulphate of zinc, chemical formula uncertain, carrying a small percentage of copper.

**SIEGENITE.** The nickeliferous variety of linnaeite, sometimes carrying small percentages of copper.

**SMALTITE.** Empirically $CoAs_2$, but always found to carry iron, nickel and copper as well as cobalt. See chloanthite for further reference to diarsenides and arsenides of copper and associated metals.

**SOMERVILLITE.** $CuSiO_3$, $4H_2O$. Same as chrysocolla except carrying double the water.

**SPANGOLITE.** A highly basic sulphate of aluminum and copper. $Cu_6$, $AlClSO_{10}$, $9H_2O$. Carries about 59.5% cupric oxide.

**SPANIOLITE.** A tetrahedrite carrying mercury.

**SPEISS.** An alloy of copper with arsenic.

**STANNITE.** Perhaps $Cu_2S,FeS,SnS$, in which the iron is partly replaced by zinc. Carries about 29% copper, 25% tin and 23% to 29% sulphur, with iron 6% to 13.5% and zinc 1.7% to 9.7%.

**STIBIODOMEYKITE.** $Cu_3(AsSb)$. An antimonial domeykite. No natural crystals have been found; artificial crystals made by Dr. Koenig are hexagonal. Cleavage: None. Fracture: Irregular and uneven. Tenacity: Very slight. Brittle. Hardness: 4. Gravity: 8.1. Luster: Metallic. Color: Gray, with yellow tinge, like domeykite. Streak: Gray. Opaque. Soluble in nitric acid, with small residue of gray powder. Occurrence: At Mohawk mine, Keweenaw county, Michigan.

**STROMEYERITE.** Sulphide of silver and copper $(Ag, Cu)_2S$, carrying about 52% silver and 31% to 34% copper.

**STUEBELITE.** A complex silici-hydrochlorate of aluminum, iron, manganese and copper, found on the island of Lipari, Italy. As determined, carries 15.25% cupric oxide.

**STUDERITE.** A varietal form of tetrahedrite carrying arsenic, iron, zinc, silver, lead and bismuth, in addition to the antimony, copper and sulphur found in the nominally perfect tetrahedrite.

**STYLOTYPITE.** $3(Cu_2Ag_2Fe)S$, $Sb_2S_3$. Copper 28.3%, antimony 31.3%, silver 8.1%, iron 7.3%, sulphur 25%. Orthorhombic. Fracture: Imperfectly conchoidal. Brittle. Hardness: 3. Gravity: 4.8. Luster: Metallic. Color: Iron black. Streak: Black. Fusibility: Decrepitates and fuses readily on charcoal. Occurrence: Copiapo, Chile.

**SUB-OXIDE OF COPPER.** Cuprite.

**SYCHNODYMITE.** Essentially $(CuNiCo)_4S_5$. A compound sulphide of copper, nickel and cobalt. Carries 17% to 19% copper, 35% to 36% cobalt and 3.5% to 6% nickel.

**TAGILITE.** $4CuO$, $P_2O_5+3H_2O$. Carries about 49% copper. Monoclinic; also spheroidal concretions with structure fibrous to earthy. Luster: Vitreous. Color: Verdigris to emerald green. Subtranslucent. Soluble in nitric acid. Occurrence: Russia and Chile.

**TALLINGITE.** $Cu_5(OH)_8Cl_2+4H_2O$. Copper about 64%. A hydrated copper cholride. Sub-crystalline. Hardness: 3. Gravity: Approximately 3.5. Color: Greenish blue. Streak: White. Subtranslucent.

**TENNANTITE.** Gray copper ore. $Cu_8As_2S_7$. Copper 57.5%, arsenic 17%, sulphur 25%. The many varietal forms of this mineral are brought about by the replacement of copper with bismuth, lead, silver, zinc, iron, mercury, nickel, cobalt, tin and platinum. Isometric; tetrahedral, also massive; granular, coarse or fine; compact. No cleavage. Fracture: Subconchoidal. Brittle. Hardness: 3.5 to 4.5. Gravity: 4.4 to 5.1. Luster: Metallic. Color and Streak: Flint gray to iron black. Opaque to subtranslucent in small splinters. Fusibility and Solubility: Same as tetrahedrite. Occurrence: At many points.

**TENORITE.** $CuO$. Cuprous oxide. Common names: Black copper; black oxide of copper. Copper 79.8%, oxygen 20.2%. Monoclinic; earthy; massive, pulverulent. Fracture: Conchoidal to uneven. Hardness: 3 to 4. Gravity: 5.8 to 6.25. Luster: Metallic. Color: Steel gray in flakes, dull grayish-black when massive. Soluble in nitric and hydrochloric acids. Occurrence: Italy, Tennessee, Lake Superior, etc.

**TETRAHEDRITE.** Gray copper ore. $Cu_8Sb_2S_7$. Greatly variable, shading into tennantite. Copper 52.1%, antimony 24.8%, sulphur 23.1%. This mineral is of protean form, frequently having a part of its copper replaced by iron, silver, mercury, zinc, lead, cobalt, nickel, tin and platinum. Isometric; tetrahedral; also massive; granular, coarse to fine; compact. No cleavage. Fracture: Subconchoidal to uneven. Brittle. Hardness: 3.5 to 4.5. Gravity: 4.4 to 5.1. Luster: Brilliant metallic. Color: Flint gray to iron black. Streak: Grayish brown to cherry red. Opaque in quantity: occasionally subtranslucent (cherry-red) in very thin splinters. Fusible on charcoal. Soluble in nitric acid. Occurrence: Cornwall, Germany, Peru, Chile, Bolivia, Arizona, Nevada, etc.

**TILE ORE.** A mixture of atacamite and cuprite with hematite and earthy material.

**TORBERNITE.** $CuO, 2UO_3, P_2O_5, 8H_2O$. Uranium mica. A hydrous phosphate of copper and uranium, frequently carrying arsenic. Carries 8% to 9% cupric oxide and 59% to 62% uranic oxide.

**TRICHALCITE.** $Cu_3, As_2O_8+5H_2O$. Carries about 34% copper. In radiated groups, columnar; also in dendritic forms. Hardness: 2.5. Luster: Silky. Color: Verdigris green. Soluble in hydrochloric acid. Occurrence: Turginski mine, Russia.

**TRIPPKEITE.** An arsenite of copper. $?CuO, As_2O_3$. Found in druses.

**TURQUOISE.** A gem stone (hydrous phosphate of aluminum) colored by 2% to 8% cupric oxide.

**TYROLITE.** $5CuO,As_2O_5,9H_2O$. Cupric oxide about 50%.

**UMANGITE.** A selenide of copper, formula $Cu_3Se_2$. Carries 54% to 56% copper.

**URANIUM MICA.** Torbernite.

**URANOCHALCITE.** A hydrous sulphate of uranium and copper, formula undetermined, carrying about 6% to 7% cupric oxide.

**VALLERITE.** A mineral containing copper, sulphur, iron, alumina, magnesia and water. Color resembles pyrrhotite. Very soft. Occurrence: At Nya Kopparberg, Sweden.

**VARIEGATED COPPER ORE.** Bornite.

**VAUQUELINITE.** Phosphochromite.

**VELVET COPPER ORE.** Cyanotrichite.

**VENERITE.** A hydrous silicate of aluminum, iron (both protoxide and sesquioxide), magnesium and copper. As determined carries about 15.25% cupric oxide.

**VERDIGRIS.** Copper carbonate. Formed from the metal by carbon dioxide assisted by moisture in the air.

**VESZELYITE.** A hydrous phospho-arsenate of copper and zinc. Percentage of cupric oxide about 37.4%.

**VOLBORTHITE.** A hydrous vanadate of copper, barium and calcium. Cupric oxide about 38.4%.

**WARRINGTONITE.** A varietal form of brochantite.

**WHITNEYITE.** $Cu_9As$. About 85% copper. Massive; crystalline; granular. Malleable. Hardness: 3.5. Gravity: 8.4 to 8.6. Luster: Submetallic. Color: Grayish white, tarnishing to bronze or brownish black. Slightly iridescent. Opaque. Soluble in nitric acid. Occurrence: Houghton county, Lake Superior, Sonora, Mexico, and Chile.

**WINKLERITE.** A highly complex hydrated carbo-oxy-arsenate of copper, cobalt, nickel and calcium, from Almeria, Spain; carrying about 15% in cupric oxide.

**WOOD COPPER.** Olivenite.

**WITTICHENITE.** $Cu_3BiS_3$. Copper 38.4%, bismuth 42.1%, sulphur 19.5%. Orthorhombic, massive and disseminated, also coarse columnar. Fracture: Conchoidal. Hardness: 3.5. Gravity: 5. Color: Steel gray to tin-white, tarnishing to pale lead gray. Streak: Black. Decomposes easily on charcoal. Soluble in nitric or hydrochloric acids. Occurrence: At Wittichen, Baden, Germany.

**WOLFSBERGITE.** Chalcostibite.

**WOODWARDITE.** A complex sulphate of copper and aluminum, carrying 47% to 49% cupric oxide and 13% to 19% aluminum sesquioxide.

**YPOLEIME.** $5CuO, 2P_2O_5+5H_2O$. A hydrous phosphate of copper of the pseudomalachite series.

**ZEUNERITE.** An arsenate of copper and uranium corresponding to the phosphate torbernite. Carries about 7.5% cupric oxide.

**ZINKAZURITE.** A mineral from the Sierra Almagrera, Spain. Essentially a hydrous sulphocarbonate of zinc and copper.

**ZINKENITE.** A sulphide of lead and antimony in which copper or silver sometimes replaces lead to a trifling extent.

**ZIPPEITE.** A hydrous sulphate of uranium and copper, carrying about 5% cupric oxide.

**ZORGITE.** A selenide of copper and lead, formula variable, giving 4% to 15.5% copper and 41% to 60% lead, with traces of silver, iron and mercury.

# CHAPTER IV.

## METALLURGY OF COPPER.

Upon this topic many volumes have been written, all of more or less value, some few dealing with the entire subject, while the majority treat of a portion only. It is manifestly impossible to thoroughly cover the entire metallurgy of copper in the limits of a single chapter, yet I have attempted, conscientiously, to review the subject, briefly but fairly, giving to each topic its just proportion of attention, and to set forth in this chapter a very short but connected and logical account of the principal features of the various processes of copper reduction. To those desirous of going deeply into the matter I can but advise careful perusal of the works of Peters, Eissler, Douglas, and others who have written exhaustively of the various branches of the reduction and smelting of copper.

The metallurgy of copper is divisible into three principal groups, these bieng pyro-metallurgy, hydro-metallurgy and electro-metallurgy—the three kingdoms of fire, water and electricity. All are more or less closely related and interdependent. Copper secured by the various wet processes must be refined by fire or electrolysis, or possibly both. The production of commercial copper by heat alone is possible, and fire is the sole element used in the purification of the native copper of the Lake Superior district. Electrolysis refining is in general use for refining crude coppers containing high values in gold and silver, and for freeing the metal from more deleterious elements.

A brief glance at the history of copper production may not be out of place. The smelting of copper must have begun at an early date, as copper and bronze have been found in tombs and disinterred cities of very great age. The copper must have been smelted, because the ancients possessed no mines of the native metal. The process of smelting was never lost and was handed down from generation to generation, from Egyptian through Roman to modern times. One of the Swansea smelters dates back from the Sixteenth century and was preceded by others of which there is little or no record. The Welsh and English were the first to engage in copper smelting as an independent industry, the practice from time immemorial having been to smelt the ore at or near the mines. As a result of the establishment of independent works that bought ore from many mines, the Welsh smelters progressed more rapidly in metallurgical knowledge than their competitors and gained great skill in handling refractory ores. As a consequence Swansea became the seat of the greatest diversified smelting industry on the globe, and the location of the city being favorable for the receipt of ore and matte consigned from foreign countries, the industry has flourished for several centuries, but of late years has declined in importance, owing partly to the tendency toward refining ores as near as possible to the mines, which is but a recurrence to the ancient practice. The decadence of the Welsh smelting industry has also been aided, beyond doubt, by the arbitrary restrictions placed on shippers until very recently.

The Swansea smelters at the height of their prosperity drove hard bargains with producers. For a ton, 21 hundredweights were demanded, and received. An allowance of 3½ pounds on 3 hundredweights was exacted for "draftage." Allowances were also claimed for moisture. No new smelters have been built at Swansea since 1867, though perhaps 75 per cent. of the world's copper output was smelted there at a period about the middle of the Nineteenth century. The Welsh port still continues as the most important independent smelting point of the world, but, for the reason that the reduction of ores can now be accomplished more cheaply near the mines in most cases, can never regain its lost prestige in the copper trade.

The first smelters in the United States were probably primitive affairs, of small capacity, built late in the Eighteenth century, but the first American smelter of which there is an authenitc record was blown in at Taineston, Maine, in 1836. The first successful American smelter was built at Baltimore in 1845, and became the nucleus of what is now one of the most important metallurgical plants of the United States. A year or two later a small smelter was built at New Haven, and from this primitive plant dates the great copper and brass manfacturing industry of the Naugatuck Valley of Connecticut. At about the same period a smelter was erected at Bergen Point, New Jersey, the precursor of the present vast works at Perth Amboy and other points on the Jersey shore. A smelter was erected at Pittsburg in 1848, and about 1850, smelting plants were built at Cleveland, Detroit, and Hancock. Smelters were built at Ducktown, Tennessee, in 1854, and since that time the process of the copper smelting industry in the United States has been steady.

In Europe there were copper smelters at very early periods in Germany, Sweden, Austria and elsewhere. At the beginning of the Eighteenth century in addition to an already extensive copper industry in Wales, there were smelters at two points in Cornwall, also in Yorkshire, Lancashire and Staffordshire, the last named works remaining in operation until 1890. There were also smelters near the principal mining centers of Germany, Austria, Hungary, Sweden, Norway, Italy, France and Russia, while in Japan and China primitive smelting operations were carried on at a number of points, and it is certain, though lacking detailed accounts, that copper was being mined and smelted, in a small way, in India, Persia, and other partially civilized countries. Copper was also secured to some small extent from the refining of the cupriferous silver ores of Bolivia, Chile and Mexico.

With the opening of many new mines during the fourth and fifth decades of the Nineteenth century, when Lake Superior, Chile, South Africa and Australia became prominent as producers; smelters, usually of crude pattern, were built at and near the mines, in many of the newer districts. The smelting of copper has now become a world-wide industry, and few of the leading copper producing countries are without large and well-managed works. The margin of profit is now so small, and the cost of transportation so great, that the larger producers are forced to produce at least the cruder forms of copper, ranging from matte to blister copper, at the mines, or near them.

Before treating of the various smelting processes, reference may be made to the impurities found in copper, with which the smelter must contend in his efforts to secure a product of good commercial quality. These impurities vary greatly in number and extent, in the ores of various districts.

Bismuth is the worst enemy of copper, and its most insidious foe. It is eliminated with difficulty, and one-fiftieth of one per cent. will cause red-shortness, while one-twentieth of one per cent. will cause cold-shortness. Bismuthiferous ores of copper are rarely smelted, except when carrying large quantities of silver, but bismuth is frequently found in ores where it apparently has no business appearing.

Arsenic, like iron, is found in nearly all brands of commercial copper It slightly diminishes electrical conductivity, but under one per cent. does not seem to affect ductility.

Lead, next to bismuth and arsenic, is the worst impurity in copper. One-half of one per cent. will make the metal cold-short, and one per cent. will ruin copper for all purposes except casting, for which use the lead is a positive advantage, as it prevents the porosity so frequently found in cast copper.

Antimony, like iron and arsenic, exists in most commercial copper, but is usually found in small percentages. It lowers electrical conductivity, but under one-half per cent. does not seem to affect ductility.

Sulphur, frequently found in excess in poorly refined copper, reduces conductivity and ductility when present to the extent of one-fourth per cent., and one-half per cent. causes cold-shortness.

Zinc forms an alloy with copper, and in considerable quantities lessens ductility, but does not greatly affect electrical conductivity. Zinc is greatly disliked by copper smelters, and a penalty is charged for smelting ores high in this element. Many otherwise promising copper deposits are unworked because of the excess of zinc, which is eliminated with difficulty. In this connection attention is directed to the successful work being done at the Pride of the West mine, in Arizona, where copper and zinc ores are secured separately by successive concentrations.

Tin, in small quantities, does no particular damage, but materially lessens ductility when present to the extent of one per cent. or more.

Iron is found in practically all copper, except that which is chemically pure, in quantities ranging from a trace up to appreciable percentages. It seems to form an alloy with the copper, and while reducing conductivity does not injure the copper otherwise, unless existing in unusual quantities.

Nickel, in small percentages, is a common impurity. It has apparently about the same effect as iron, to which it is related, and beyond a slight reduction in conductivity has no apparent bad effect.

Silicon, even in fractional percentages, causes a marked decrease in electrical conductivity, but up to 2 per cent. does not affect ductility. Three per cent. causes brittleness, and above 5 per cent. the metal is rendered too brittle for any ordinary use.

Phosphorus, in the minute quantities usually found in copper, has no particularly bad effect, but one-half of one per cent. will cause red-shortness.

Tellurium, even in minute quantities, produces red-shortness and cold-shortness, though not greatly affecting conductivity or ductility.

Carbon, in the form of carbon dioxide, may be absorbed by copper at a critical pitch of the metal, and produces porosity, though apparently having no other effect. This, or other gases, absorbed by the copper when in a molten state, are let out as the metal sets, thus producing a more or less porous structure.

A peculiar feature of cuprous oxide is that it will melt, at red heat, without decomposition, and frequently becomes a component of the refined metal. Cupric oxide, in small quantities, has no apparent effect on the metal, but in quantities of one-half per cent. or more lowers ductility, though not injuring the metal in other respects, even if present in quantities up to ten per cent.

In the various processes of smelting, a variety of semi-metallic compounds are formed before the metal itself is produced. The first product of fusion is known as matte, or regulus. It is difficult to define copper matte, because it may contain greatly varying proportions of any of its elements, and a considerable variety of elements, of which copper and sulphur are necessary, while iron, arsenic, and a long list of impurities, valuable and damaging, are found in greater or less number and percentages in various mattes. Matte may contain as little as 15 per cent. of copper, or as much as 70 per cent., though usually ranging from 25 or 30 per cent. in the lower grades up to 50 or 55 per cent. in the higher. The tendency of modern practice is away from the old plan of blowing up the matte to blister copper by easy stages. In the most modern plants the matte is blown up to blister copper in two or three fusions from the calcined ore. Copper matte is variously considered as an alloy, a chemical compound, or a mechanical mixture. It is obviously a semi-metallic product, possessing certain of the characteristics of metal, such as malleability, which is quite marked in the case of some high-grade mattes.

Blue metal is a high-grade matte, carrying 60 to 65 per cent. copper. White metal is a matte running 70 to 75 per cent. copper, and pimple metal carries 80 to 85 per cent. copper. Black copper is impure metallic copper carrying 1 to 5 per cent. sulphur, besides sundry metals and metalloids as impurities. The name comes from the oxidization of the surface to a dull black. Blister copper is the highest grade of unrefined metal, carrying 96 to 99.5 per cent. copper, with one per cent. or less of sulphur, besides varying impurities. Its name comes from the blebs or vesicles in which the bubbles of gas from sulphur and other volatile elements are retained, as the copper hardens. Blister copper looks well, and is suitable for many uses, but is nearly always red-short, though not cold-short. It naturally varies considerably, the purer grades being practically a good quality commercial copper.

Cement copper is a reddish precipitate, composed of metallic copper and sundry impurities, requiring reduction and refining before use, being usually brought to blister copper, then refined. Copper bottoms are alloys of metallic copper and metals existing in the matte as impurities, formed in matting. Their formation leaves the matte purer, and the bottoms are resmelted and refined.

Finished copper is put out under many different names and brands. The principal English brands are "best selected," for brass foundries; "tough copper," for wire and sheets, and "tile," which is brittle, and suited for castings only. "G. M. B." means "good merchantable brands," and is sometimes stretched and sometimes contracted in meaning, according to whether buyers or sellers hold the whip-hand. "Chile bars," are bars of blister copper from Chilean smelters, ranging from 95 to 99 per cent. pure, and are refined before use. The principal American grades are "Lake," a very tough and ductile copper from the Lake Superior native copper mines; "electrolytic," produced by electrolysis from blister copper; "standard," which means almost anything that is neither very good nor very bad, and "casting," which, as its name implies, is suitable for castings only. The metal is turned out in a variety of forms, as ingots, molds, cakes, wire-bars, anode bars, etc., according to the particular use for which the copper is destined.

As most copper ores occur disseminated through gangue-rock, the first process of conversion into metal is one of concentration. By crushing the disseminated ore and worthless gangue, the ore, by reason of its greater specific gravity, can be separated from the gangue to a considerable extent. There are many variations, according to local conditions, but in the main the process of concentration is identical. The heavy ore is first reduced to smaller size, then concentrated by gravity, with the aid of water and jigging. Hand-picking is sometimes resorted to, and there is a dry process concentrator, in which air is used instead of water, this being suitable for districts where water is scarce and expensive. The first crushing is usually done with jaw-crushers. Gyratory crushers are sometimes used, and give good work, copper ores not being so liable to sliming as softer ores, such as galena. The next process of reduction is usually to pass the crushed ore through trains of Cornish rolls, for further reduction. Occasionally smaller jaw crushers are used, and sometimes rolls are used exclusively for crushing.

After reduction to desired size the ore is passed over jigs. These are of many patterns, but the essential principals are the same in all, the lighter gangue being driven off by a combination of movement in the jig and the force of running water, the vibration and water jets being so regulated as to permit the ore to remain while worthless rock is washed away. No matter how carefully this work is done, a little ore is lost, and a little rock remains with the concentrated ore. In modern mills the "fines," or very small particles of crushed rock and ore, are passed over patent concentrating tables, or the old style round-tables, for the saving of the very minute particles.

In the Lake Superior district, where copper is found native, the processes of concentration and smelting differ slightly from those used elsewhere. The metal sometimes occurs as masses weighing from a few pounds up to hundreds of tons. The larger masses are cut underground, with long-handled chisels, to sizes that can be hoisted, and when on the surface are hand-cobbed to separate as much as possible of the adhering gangue, then put directly into the furnaces for smelting, The smaller masses are cobbed under steam-hammers, and also sent direct to the smelter. The bulk of the ore occurs as disseminated particles of small size, scattered through amygdaloid or conglomerate rock, in quantities from one-half of one per cent. to 10 per cent. This rock is hoisted to the surface as broken, put through one or two crushers in a rock-house which is part of the shaft-house, sorted by passing over grizzlies, then dumped direct into hopper cars and carried to the mill. Ore from the cars is dumped into bins at the top of the mill, thence fed by gravity under the stamps, which are very powerful, and actuated by steam, the feed being regulated by an experienced workman in charge. Such stamps, of the most modern design, crush 400 to 550 tons each, per working day of 20 hours, the rock being exceedingly refractory. From the stamps the crushed rock is fed to jigs, a portion of heavy copper being secured direct from the mortar boxes. The jigs are in series, taking coarse and fine sands from the stamps. A portion of the coarse sands discharged as tailings are recrushed and rejigged. The fines, or slimes, are passed over slime-tables of various patterns, those in principal use being the old-style Evans round-table, sometimes with two or three decks to save floor space, and the Wilfley and Overstrom patent tables, whereon concentration of fine metallic particles is effected by a combination of oscillatory motion, water jets, and parallel ridges on the bed of the table. The waste sands are washed away by strong currents of water, and piled some distance from the mill, while the concentrated metal with its adhering gangue-rock called "mineral," is taken to the smelters for reduction. The former practice of dressing this mineral to a high percentage of metallic contents is giving way to an opposite course, all of the Lake mills now dressing their mineral to much lower grades than formerly, it having been found that the cost of smelting mineral, which is about $5 to $7 per ton, renders it more profitable to fuse the extra gangue-rock than to lose the large amount of fine copper formerly going away in the slime sands. The mineral produced by the Lake mills now ranges from 50 to 85 per cent. metallic copper. Many of the big mills make several different grades of mineral, varying in richness as well as in size of the nodules of metal. There is more or less hand-picking of the coarser grades of mineral for particles of silver, and a small percentage of the refined copper turned out is treated electrolytically, to save the silver that would otherwise be lost. The Lake copper carries no gold.

The smelting of Lake copper is done in blast furnaces, often of considerable size. The crude mineral is charged in the furnaces with fuel, usually anthracite coal, though coke is used at a pinch, and limestone for flux. The product of the first fusion comes as impure copper and cupreous slags, the latter being resmelted. The crude copper is refined by a successive smelting. The refined copper always contains more or less silver, with traces of iron, arsenic, etc. Commercial brands of Lake copper are always less pure, chemically than high-grade electrolytic copper, but the Lake product possesses superior ductility and is especially desirable for wire-drawing and similar uses.

The great bulk of the world's copper supply comes from sulphide ores. While leaching processes are employed at many mines, the greater part of the sulphide ores is reduced by heat alone, and in such cases it is desirable that as much as possible of the sulphur be eliminated before the ore goes to the smelter, unless the system of pyritic smelting be employed. To accomplish the partial oxidation of the sulphur in sulphide ores, such ores are given a preliminary roasting or calcination. This may be accomplished by heap-roasting in open air, or by roasting in stall, shaft or kiln furnaces. Heap-roasting on a large scale causes the destruction of vegetation for several miles away, because of the fumes of sulphurous and sulphuric acid driven off.

The processes of heap-roasting, while identical in the main, differ greatly in almost every detail of practice. It is perhaps applied most successfully at the Rio Tinto mine, where the heaps are of enormous size, and are burned with a marvelously small amount of carbonaceous fuel. At this mine hand-selected rich ores, averaging 8 to 10 per cent. copper, are piled in heaps of about 400 tons, and fired with a single cord of wood, such heaps burning 6 to 9 months each. The time ordinarily required for roasting an average heap is 30 to 90 days, 60 days being perhaps a fair average. The ground for a roast-heap cannot be prepared with too much care. Allowance should be made for sufficient slope to provide good drainage, and ditches should be dug to carry off rain water, and also to divert the drainage of adjacent ground, as a large proportion of the metallic values may be leached out by water in a short time. The ground is usually surfaced with broken rock or slag, and given a final top-dressing of clay, well rolled or pounded. Above this should be placed a layer of fines, three to six inches deep, to prevent baking of clay and its inclusion with the roasted ores, when the latter are removed. On this surface of fines the roast-heap proper is built. There is a first layer of wood, much or little according to the nature of the ores, and usually more than is really needed. The worst wood available will do very well, if care is taken to furnish a little good wood for kindling the fire-Channels are provided, so that after the wood has burned out there is draught through the heap. Chimneys of boards are built at various points, the number of channels and chimneys depending on the size of the heap. In American practice a cord of wood is used for an average of 30 to 50 tons of ore, the percentage of fuel growing less as the size of the heap is increased. The first layer of ore is of coarse lumps, 2 to 6 inches in size, or even larger, surmounted by a layer of "ragging," or medium-sized lumps, and topped with a layer of fines. The greater the percentage of sulphur, the lower the height of the pile. The shape of the heap on the ground may be square or oblong, usually the latter, to facilitate upbuilding and removal. In a roast yard it is necessary to have a considerable number of heaps, so that the process may be continous. The heap is fired, after building, and the wood gradually kindles the sulphur in the ore which continues to burn for many weeks. The success or failure of the process depends mainly upon careful handling, the heap requiring a small but steady supply of air, for even roasting. Too much air allowed to enter the heap will result in matting part of the ore. Heap-roasting requires a great deal of hand-labor, and has various objectionable features, which restrict its use.

Ores are also roasted in kilns and in stall and shaft furnaces. A stall furnace is merely a perfected form of heap-roasting, wherein brick, stone or slag-block walls are built about the roast-heaps, regulating the air currents. At times a cover is built above, thus preventing the access of rain-water, which would quickly leach out a large part of the copper values. In the most modern forms of stalls, paved or grated floors are added, and stalls grade into furnaces by the addition of flues and chimneys for the carrying off of the roast-gases.

The fumes of sulphur from roast-heaps are very objectionable, and also wasteful. Such fumes can be kept from the air and utilized in the making of sulphuric acid, by passing through lead-lined acid chambers, in which the acid fumes are taken into solution by water. Shaft-furnaces are especially used where the fumes are saved for the manufacture of acid. The Gerstenhoefer is perhaps the best-known form of shaft furnace. This consists of a vertical shaft with a mechanical device for feeding the charge from above, and the fresh, pulverized ore, is intercepted in its downward progress by projecting ledges, thus permitting its partial oxidation. Kiln-roasting is also employed where sulphurous fumes are saved for acid making, the kilns being of shaft-like form. This process has the advantage of permitting a much more complete desulphurization than is possible in heap or stall-roasting. Matte is sometimes heap-roasted, requiring several successive burnings. The practice is of doubtful utility, unless in exceptional cases.

The roasting of sulphide copper ores may be reducing or merely oxidizing in nature. The calcination of copper ores is an apparently simple process but in practice requires nice discrimination and great care to secure the best results, owing to the varying proportions of copper, sulphur, iron and other elements found in the raw ores. The skill and care with which the calcining is done greatly affect the costs and success of the future processes of reduction. As the combinations of ores and requirements are almost innumerable, the practice in one district is usually more or less different from that of another, and even mines in the same district do not always perform their calcining in a precisely similar manner. Securing the best possible results in each case calls for individual treatment by a metallurgist skilled in practice as well as in theory—and more especially one skilled in practice.

Calcining may be performed in hand furnaces, but automatic devices are more economical, and are in general use in all but the smallest and least modern works. Hand reverberatory furnaces with a hearth heated by a fireplace separated from the furnace by a bridge-wall with side openings, give as good satisfaction as can be secured with hand furnaces. Muffle furnaces are sometimes used. These give a very equable heat, but are expensive in operation and not generally used. There are various forms of cylinder calciners, among the best of which is the Douglas muffle cylinder calciner, with continuous discharge. This has a central flue of tile, which takes combustion products direct to the chimney. This is suited for general work, but is especially adapted for the economical and cleanly saving of sulphurous fumes for the making of acid. Hand-power cylinders are occasionally found in use, but are as expensive and wasteful as hand-power apparatus of any sort, where mechanical means can be found for doing the work. The Brueckner automatic intermittent discharge cylinder has a greater diameter and shorter length than other varieties of cylinders, and is in more general use than the other varieties, as it takes less floor space and is automatic and efficient in operation.

The principal form of calciner is the automatic reverberatory, of which there are a number of patented varieties, all of more or less value. These consist essentially of stationary reverberatory furnaces, through which plows are dragged to rabble the calcining and remove the calcined ore. One of the best forms is the turret furnace, in which horizontal revolving plows are actuated from a central shaft, while the ore charge is fed automatically from hoppers above. The turret furnace is economical of floor space and attendance, and may be built double or triple decked, if desired. In calcining ores a certain amount of copper is volatilized, and carried off with the roast gases, but in all modern plants such copper is saved in dust chambers, where it is deposited and whence it is afterward removed and smelted. As flue dust is usually high in arsenic and antimony, volatile elements that are highly deleterious to finished copper, flue dust is commonly smelted by itself, though sometimes mixed with matte.

The fuels used in smelting copper are of considerable variety, and depend somewhat upon availability and price, as well as local requirements. Anthracite and bituminous coal, coke and charcoal are used. Coke is in most general use, while charcoal is usually obtainable at more remote points only. Anthracite coal is a very good fuel for most purposes, but unobtainable at reasonable prices in the majority of districts, while bituminous coal is the most objectionable fuel, and, next to charcoal, the least used, though there is such a great difference in the nature of soft coal that some varieties work well in partial or complete fuel charges, while others give most abominable results. Gas is also used at a few points, and seems suited for reverberatory furnace work. There seems no good reason why petroleum, properly sprayed, should not serve the same purpose. The nature of a charge placed in a furnace necessarily depends, first, upon the available ores, and secondly, upon the nature of the principal ores requiring smelting. In practice it is desirable to blend various copper ores, where the necessary grades can be secured, rather than to add barren fluxes, but this is, of course, a matter depending upon the availability of the ores desired. One of the secrets of the success of the big custom smelters is found in their ability to mix various ores from different districts so as to lessen or entirely eliminate the use of barren limestone or iron ore for fluxing. The use of "sweeteners" is to be commended, where such ores are obtainable at reasonable prices. Ferruginous ores are required for mixture with silicious ores. Local conditions regulate practice, and the soundest theories must often step aside in the presence of prohibitory freight rates; and high freight rates are common in many of the greatest copper producing districts of the world.

Furnaces for the smelting of copper ore are of two classes, the blast furnace, which has a powerfully reducing atmosphere, and the reverberatory furnace, where a reflected flame gives a neutral atmosphere. The blast furnace is a device so ancient that the date of its invention is unknown. In its crudest form it is but an oven in which ore and fuel are placed together and air pumped in to aid in reduction. The modern improvements on the blast furnace have been in the direction of enlarged capacity and details, the central plan remaining the same as a thousand years ago. There were blast furnaces for the reduction of copper ores in existence in very early days at Eisleben, Germany; at Roros, Norway; in Atvidaberg, Sweden; at Perm, Russia, and in other parts of Europe. The development of the blast furnace to the present day size and efficiency has been accomplished by a steady succession of little improvements, covering many centuries, rather than by single strides, yet it may be said that blast furnace smelting has been improved more in the past thirty years than in the preceding five centuries.

The smelting of copper ore in a blast furnace is the process of reducing the metal from its ores or gangues by the use of carbonaceous fuel, usually coke, in an oven having a blast of air, which may be drawn direct from the atmosphere, or heated before passing through the tuyeres. This process is adapted to the reduction of practically all of the copper ores. In addition to the charge of ore, fuel and fluxing elements are added, the flux being cupriferous or barren, as circumstances may dictate. One of the greatest improvements of modern days in blast furnace practice has been the invention of the water-jacket. This was devised at the Longfellow mine, Arizona, in 1874. The smelter was 800 miles from a railroad, fire-brick cost one dollar each, and were of short life, the ore being highly basic. As it was manifestly impossible to make enough copper to pay for the furnace linings, the experiment was tried of using iron sides for the furnace, with hollow walls, through which water was circulated. This proved a success, and is now in very general use, water-jacketed cupolas being far more common at present than those with fire-brick linings. Despite the considerable loss of heat resulting from the circulation of water between the inner and outer shells, the water-jacketed cupola has proved itself both efficient and economical. Such furnaces are now built with daily capacities of 200 to 300 tons. The shells are usually circular or oval, with jackets of cast-iron, wrought-iron or soft steel, and copper is frequently used.

Reverberatory furnaces are a Welch invention, dating only from the last quarter of the Nineteenth century, and after running the gauntlet of conservatism have so effectually proven their value that their utility is no longer questioned. Reverberatory furnaces are adapted to all classes of ore, but are more especially suited for the reduction of sulphides, for which purpose they unquestionably lead the old-style blast-furnace. In the reverberatory furnace the flames from a lower grate, on which the fuel is fired, are reflected back upon the ore charge, lying on a bed above, thus giving a neutral atmosphere. The fore-hearth is brick-lined and movable, and the air entering the furnace is frequently preheated. In the best practice five to seven tons of ore are smelted per ton of fuel consumed, the larger furnaces giving the higher duty. Furnaces of this pattern having a daily capacity of 250 tons are not uncommon, and even larger have been built and operated successfully. In the case of sulphide ores it seems certain that reverberatory furnaces produce a richer matte from similar charges than do blast furnaces.

In the case of oxide and carbonate ores, the smelting is done in the same manner as previously described in the treatment of the native copper of Lake Superior. With the sulphide ores the process differs. The raw ore is roasted, or more frequently calcined, before charging in the furnaces, commonly of the reverberatory type. Under the influence of the reverberatory blast chemical reactions are set up that lead to the volatilization of a considerable portion of the sulphur, also part of the other volatile elements, such as arsenic, etc. The product of the first fusion is secured as a low-grade matte. If the charge is blown up to more than 50 per cent. at the first smelting the slags will probably show too much copper, entailing direct losses or resmelting. The old practice was to bring the low-grade matte from the first fusion up to blister copper by successive smeltings, in easy stages, but the modern practice is to bring the matte to high grade by as few fusings as possible, and the former heavy losses in slags have been minimized by close attention to details.

The "direct method" of copper refining consists essentially of the fusion of a mixture of raw and calcined matte of about white metal grade, the resultant product being blister copper.

The "reactor process," for which much is claimed, and from which much is hoped, is a patented system for the production of blister copper from mattes of all grades by a single fusion. The essential features of the process are the mixture of superheated steam and fine sand with atmospheric air, which mixture is drawn into the furnace through two or more sets of tuyeres, striking the surface of the molten charge and setting up a circular motion therein, which keeps the matte free from slag, and exerts both an oxidizing and a scorifying process simultaneously. It is claimed that gold values present in the charge will be precipitated in the first matte, and that matte ranging in tenor as low as 15 per cent. can be brought up to blister copper at a single fusion, in a very short time, and that the blister copper so obtained will range above 99 per cent. in tenor, and prove remarkably free from the impurities present in the matte, which, normally, would be expected to appear in considerable quantities in the finished product. It is evident that the inventors of this process have a wide field before them, if their claims can be fully substantiated in furnace practice.

The process of conversion first applied to steel making by Bessemer, and now in general use in the manufacture of steel, was eventually applied to copper smelting, after no little unsuccessful experimenting. The first successful plant for the bessemerizing of copper matte was built in Lyons, France, in 1881, by Pierre Manhes. This process was adopted shortly afterward at the Parrot mine, Montana, where it was greatly improved over the French practice, and from that time its general adoption for the conversion of matte into blister copper may be said to date. The process, as now in general use, consists of burning out the sulphur and allied impurities in the converters, some of which are of very great capacity, having been built as large as eighteen tons. This process is completed in one heat, and the sulphur in the matte is made to work its own destruction under the influence of the blast. The process is an economical one, but should be followed by electrolytic refining to give a pure copper of high conductivity and also to save the precious metals usually contained in blister copper.

The first converters were made of one ton capacity, but now rarely run less than ten to fifteen tons in size, in the modern smelters. The crude copper is run from the furnace into the converter in some cases, thus saving re-heating. Owing to the greater specific gravity of gold and silver the precious metals tend toward the bottom of the converter, and can be saved to some extent therefrom, but this process is so crude and wasteful that the gold and silver are now generally parted by electrolysis in a later operation.

Converters are built of steel, in various sizes, sometimes of great capacity, up to 15 or 18 tons. The boiler-plate shell is made in three parts, strongly bolted together on the flanged parts, and is lined with fire-brick, or, more often, tamped gannister, cemented with clay. In the best arranged plants the copper is run direct from the cupola well of the melting furnace into the converters, thus saving loss of heat. A blast of five to fifteen pounds per square inch, furnished by an air compressor, is then blown through the molten charge, the converter blowing off into hoods that connect with flues running to the dust chamber. The number and size of the tuyeres through which the blast enters the retort vary with the style and size of the converter, which is mounted on trunnions, and provided with mechanical power for tilting. More or less copper, volatilized by the blast, is driven off, but saved in the dust-chambers, and resmelted as flue dust. In the best practice ten to fifteen-ton converters handle full charges and turn out finished blister copper of better than 99 per cent., in one to one and a quarter hours.

Pyritic smelting is a process of reduction in which the sulphur in the ore, itself a valuable fuel, is made to work its own destruction. In ordinary smelting practice the sulphur must be driven off, with great labor and trouble, through the employment of carbonaceous fuel. This process is, of course, adapted solely to sulphide ores, and apparently to only a portion of these, as sufficient silica is required to hold the iron in slag. Whether silicious ores might not be added to sulphides deficient in silica is a matter for experiment. In practice it is usually found advisable to use a little coke to start the process of combustion, but this merely serves as kindling, the real fuel being the sulphur in the ore itself, which unites with oxygen entering the furnace and passes off as sulphurous fumes, the iron in the ore also being partially oxidized at the same time. Sulphide ores occasionally require the addition of oxide ores to serve as a fluxing agent. The first cost of a pyritic smelting plant is less than that of an ordinary smelter of the common type, and, as fuel is the greatest single item of cost in the operation of a copper smelter, the cost of operation is materially lower in pyritic smelting than with any other process. The cost of calcining is saved, and the fuel bill is reduced from 60 to 90 per cent. The atmosphere is neutral, and impurities are eliminated more readily than in other smelting. It seems the coming process for such ores as it is adapted to, but it must not be thought, from the manifest advantages of the system, that it will do for all sulphide ore properties. Its adoption should not be decided on in the case of a new mine until the best expert advice has been had, and careful consideration given to every possible factor in the case.

Pyritic furnaces are charged in two ways. In layer charging the raw crushed ore is intimately blended with a small proportion of coke, and fed into the top of the furnace, there being gradual heating until the ignition of the entire mass. A low-pressure blast is used, resulting in partially roasting the ore before it reaches the smelting point. In column charging the raw crushed ore is fed into the smelting zone of the furnace, and a strong hot-blast aids in the process, exercising a bessemerizing effect. When properly operated a furnace worked with a column charging gives matte of good grade, with exceptionally clean slags, has a large capacity and effects a big saving in fuel.

The scoria, or worthless waste material from a smelter, accumulates in large quantities, and its disposal is a matter of importance. Various plans are in use for handling and disposing of the slags. The simplest is to let it run outside and care for itself, but this is possible only where there is a sharp incline and plenty of waste room, conditions usually lacking. The cheapest plan is, probably, to granulate the slag. This is done by running the molten slag into a trough conveying a stream of running water. The slag granulates instantly and is washed away by the water, and deposited by gravity at whatever point desired. It may also be taken out in slag-pots, by hand, horse or mechanical power, or may be run out in gutters, while liquid. One valuable use of this material is the making of slag brick, which, while not suited to general use, are frequently available about a smelter. The chemical composition and physical properties of slag vary greatly, according to the nature of the ores and fluxes used in the smelter charges, but most slags are rich in iron and silica, and make excellent brick for certain rough uses. Whether cement might be made from copper slags is undetermined. The Illinois Steel Company makes an excellent cement from its iron slags, but the excess of iron in copper slags might impair the setting qualities of a cement made therefrom.

The hydro-metallurgy of copper is a special branch of the art, and one which has reached its highest development on the Iberian peninsula, where its use has resulted in the development of several very large mines, which, without its aid, could not be worked at a profit. The use of leaching processes implies a final blowing up of the product in a blast furnace, but in the main the work is accomplished by heap-roasting, leaching and cementation, in the case of sulphide ores. Lixiviation is especially adapted to sulphide ores of low grade, but it is not every low grade ore that can be handled advantageously by leaching, as it is not adapted to ores containing considerable quantities of the ferrous oxide, manganese or lime. The leaner oxides and disseminated sulphides having quartz gangues are especially suited to lixiviation. The great disadvantage of the process is that it is very slow, and locks up enormous quantities of ore, which means a heavy investment in unavailable ores and partly finished products, at all times.

The leaching processes vary, according to the nature of the ores, and in minor details, but may be broadly divided into three groups, one for oxide ores, one for sulphides, and one for sulphates, the latter receiving the same treatment whether produced naturally or artificially. In the case of old copper openings, the waters percolating through the sulphide ores gradually leach out the metal, which is carried in solution as sulphate of copper, and can be easily precipitated upon scrap iron. The mines of the Sierra Morena, in Spain and Portugal, have been worked intermittently for at least three thousand years, and immense piles of low-grade sulphide ores and refuse have accumulated. As these weathered, the natural lixiviation was perfected, and all that is needed to save the copper is to deposit scrap iron in the path of the leach water. Upon the iron the red metal is deposited, while the iron is gradually consumed, and turned into copperas by the free sulphuric acid set free from the leach-water. The process of securing copper from sulphate solutions is now used at many old mines, resulting in small annual production, and is employed in certain districts for saving copper from water pumped out of the mines.

The process of natural cementation is well exemplified at the San Domingos mine, Portugal. The low-grade sulphide ore is cobbed to three or four-inch size, and piled in immense heaps, 15 to 40 feet in height, which are provided with valleys for drainage, with brick chimneys at intervals. Pipes are laid over the surface of the heap, and water applied copiously at intervals. The water draining out of the heap is collected in sluices, and the metal carried in solution as copper sulphate is precipitated in metallic form on scrap iron. Such heaps may contain a million tons of ore, and require eight or ten years for leaching.

What is called artificial cementation is best exemplified at the Rio Tinto mine, in Spain. Broken ore is piled in roast-heaps, called teleras, in quantities of 1,000 to 1,500 tons to the heap, the ore ranging from one and a half to two per cent. in copper. The heaps are fired, burning slowly for three to six months, after which the ore, then thoroughly and uniformly roasted, is placed in cement tanks which are some five feet deep by one hundred feet long, and thirty-five feet wide, and provided with false bottoms of square timber. The ore is then leached, the leach water running into settling tanks, where the copper is precipitated on pig iron. There are five or six successive leachings, after which the leached ore is taken out, piled in heaps called terreros, and weathered again, for releaching. Some idea of the immensity of the scale on which the Rio Tinto is operated may be gained from the fact that the mine has about seven million tons of low-grade ore in terreros at the present time.

Copper sulphide ores are converted into sulphates in three ways. The first of these is by weathering, which induces a process of natural decomposition, as instanced in the case of the San Domingos, previously cited. The second method is that of slow-roasting, as just cited in the case of the Rio Tinto. The third system, which is employed at the Rio Tinto, and other mines, consists of roasting copper sulphides with ferrous sulphate, which converts the bulk of the product into copper sulphate. Sulphate of iron is freely produced in the cementation of copper, hence is readily available at small cost, at the Rio Tinto and other mines producing cement copper, in addition to which there is an immense supply of ferrous sulphate (copperas) produced in the weathering process preliminary to cementation, as the Rio Tinto and other Huelva ores are chalcopyrite, which is a compound sulphide of copper and iron. In the chemical reactions attendant upon weathering, large quantities of ferrous sulphate are produced, and this, after further oxidation, reacts to free sulphuric acid and basic iron salts, the free sulphuric acid attacking the copper and changing it into copper sulphate, which is held in solution and may be made into crude commercial form by evaporation of the water, or precipitated in the form of cement copper, as is desired.

Copper sulphides may also be converted into chlorides by two processes, both of which are used in the Hispano-Portuguese cupriferous fields. In the first of these processes the sulphide copper ores are treated with ferric chloride, or with ferrous chloride and hydrochloric acid. Decomposition is hastened by saturating the ores under treatment with calcium chloride (chloride of lime), or sodium chloride (common salt). The second process, which is quicker, and also gives closer extraction, though the cost of treatment is higher, consists of roasting the raw sulphide ores with a liberal addition of salt. This is known as the dry chloruration process, and is in extensive use at the Rio Tinto, where the ores receive an addition of about one and three-fourths per cent. common salt, and the mixture is roasted in teleras. The chlorurized ore is then leached in vats, as already described, and the residuum is placed in terreros for further weathering and ultmately a second leaching. A modification of this process is in use at Natrona, near Pittsburg, where residues of Spanish pyrites used in the manufacture of acid are treated by what is practically the same process, though conducted somewhat more expeditiously and expensively. The process is also in use at several Canadian and American points, on a small scale.

The Doetsch leaching process is not in present use, though once employed extensively at the Rio Tinto. This system provides for the treatment of raw sulphide ores, which are mixed dry with about one-half per cent. of ferrous sulphate and salt. The ore is broken to half-inch size, and with the ferrous sulphate and salt is built up into large heaps having channels and chimneys for ventilation. In about two years the weathering is completed, and the copper held in solution in the leach water, amounting to about 80 per cent. of the assay value, is precipitated on iron.

The earlier wet process of Langmade was improved by Henderson in 1860, and remains, with slight modifications, in quite extensive use. It is designed for the extraction of copper from the cinders of cupriferous iron-copper pyrites remaining after the extraction of the sulphur used for the manufacture of sulphuric acid.

The Hunt & Douglass process is an improvement upon the Doetsch leaching process, and while based upon the same general plan, is a modification better adapting the system to the economical work that is now necessary for the earning of profits in the copper trade.

The cement copper resulting from the precipitation of copper from cuprous sulphate solutions upon scrap iron is a very impure mixture of metallic copper with iron, antimony, arsenic, silica, etc., and is washed before reduction to blister copper in blast furnaces.

The principle of electrolysis, or the parting of metals and the redeposition of one of them by the aid of a continuous electric current, was discovered by Faraday in 1839, but was not applied practically to copper refining until 1881, when the Balbach smelting works at Newark, New Jersey, put in a small electrolytic plant. Despite the obstacles met with at the start, the process gave such promise of success in the perfect separation of copper and its allied metals that its introduction was rapid. The process was improved speedily, and three years after its first use in the United States electrolytic plants were in operation in Wales, England, France and Germany. For the refining of blister copper it has no competitor, and is now the cheapest as well as the most thorough process for the refining of all rough coppers.

The process of electrolytic refining, producing copper of that name, is a step in advance of the old methods that produced copper of merchantable grades, though containing considerable impurities, of which gold and silver, especially the latter, were the principal. It being evident that the precious metals did not add to the value of the copper, but were themselves of great value if it were possible to separate them from the copper, various plans for parting the metals were tried, but none of them were completely successful until the perfection of the system of electrolytic refining.

There are two principal systems of electrolytic refining, with a variety of modifications of each. These are known as the series and multiple systems. The former has electrodes in series and tanks in series, or, more frequently, in multiple series. The multiple system has electrodes in parallel arcs, with tanks in series. The series system requires a much greater electromotive force than the multiple plan, and the latter is in more general use. There are a dozen electrolytic refineries in the United States, and no two of them are built or conducted on exactly the same plan, though the main features of the work are similar, the modifications being principally in the minor details. The success of the entire system hinges upon the fact that under electrolytic action metals are dissolved at the negative pole of a battery, and redeposited at the positive pole,. when free circulation is permitted in a favorable solution. Varying electric currents give varying effects, and some metals pass over sooner than others, copper being one of the first to go over. As the unrefined copper contains a variety of metals in most cases, it is important that the electrical current be so regulated that none of the other metals pass over at the same time as the copper, or the object of the work is defeated. Not only must the current be carefully regulated, but the nature and circulation of the electrolyte are of prime importance, in securing thorough and economical practice.

Connections between dynamos and tanks are made of high-conductivity copper, necessarily of large size to carry the heavy current used, and of varying forms in cross-section. The tanks may be of wood or slate. The wooden tanks are usually lined with lead, tarred felt, or asphalt, lead being preferable. These tanks usually have their tops about flush with the floor, to permit easier handling of material, and are terraced in series, thus providing for a natural circulation of the electrolyte, which is pumped into the upper tanks, and flows thence, by gravity, into the other tanks of the series. Overhead trolleys, running along the galleries and aisles between the tanks, provide expeditious means for bringing in the anodes and taking out cathodes, which, in a large plant, are constantly being added and withdrawn, although the making of a single cathode requires several weeks. The anode bars are cast from blister copper, usually running from 98 to 99.5 per cent. pure. These may be made at the smelter, or cast at the refinery from blister copper melted in a cupola furnace kept running for the purpose. Anodes are cast in a variety of forms, but more commonly are thin plates with projecting lugs that rest on the top of the sides of the tanks, one lug resting on the electrical conductor, while the other is insulated.

The composition of the electrolyte varies at the different plants, containing from 5 to 6 parts of sulphuric acid, 15 to 20 parts of bluestone and 75 to 80 parts clean water. The average composition is 16 to 18 parts bluestone, and 6 parts of acid. The heating of the electrolyte promotes the process of decomposition and upbuilding, and produces a smoother deposition of copper on the cathode.

The cathode plates are made of strips of rolled copper about one-quarter inch in thickness, and of varying sizes and forms. These are made from copper sheets, then oiled and coated with fine graphite, to assist in electrical deposition. The process of refining is necessarily continuous, to secure the best results metallurgically and financially, but from two to four weeks is the average time required in making an average cathode. Including the time required in remelting and in various other uses, it may be said that five to six weeks time is required for the making of finished cathodes from the rough copper received, though a much shorter time may suffice in some plants, under exceptionally favorable circumstances. The rate of progress secured depends quite largely upon the purity or impurity of the anodes, the process of electrolysis being greatly facilitated and cheapened by comparatively pure anodes.

As the anodes are torn down and the cathodes built up under the steady effect of the powerful electric current, the pure copper, with minute traces of the impurities present in the anode, is carried over to the positive pole. The great bulk of impurities in the anode are precipitated to the bottom of the tank, as sludge, or slimes. A certain infinitesimal amount of the impurities present in the anode will find their way into the cathode, but not to sufficient extent to injure the product for any commercial use. If more than traces of the impurities are carried over, it is because the electrolyte has become foul, or the current is wrong, or there has been serious carelessness somewhere. The chemist at an electrolytic refinery earns his full salary, for he must be working every minute he is on duty, as frequent assays of anodes and cathodes, and at least tri-weekly determinations of the electrolyte are required. There are local aberrations peculiar to the process which are liable to affect any or every tank, and even individual anodes, requiring constant watchfulness from superintendent, electrician and chemist. The sludge precipitated to the bottom of the tank may form a conducting plate, giving rise to short-circuiting, and should be removed before large accumulations occur. When the electrolyte becomes too foul for proper use, it is purified, brought up to the proper standard, and pumped back into use again. The slimes at the bottoms of the tanks are siphoned or bailed out, taken to the slime tank, and copper scraps picked out by hand, after which the copper remaining therein is dissolved out by a solution of two to three parts 66 degree sulphuric acid with one part water. The remainder of the precipitate, which may contain gold, silver, tin, lead, zinc, antimony, bismuth, etc., is washed, dried, mixed with soda-ash and then smelted down to base bullion, from which the gold and silver are parted in the usual manner.

The electrolytic refining of copper has been greatly improved during the past decade, and is now in very general use. In 1892 the output of electrolytic copper was about 25,000 tons. Three years later it was 87,000 tons, while in 1898 the output was estimated at 157,000 tons, and for 1902 was probably nearly 250,000 tons—a gain of ten-fold in ten years. The process is in such general use because it serves a two-fold purpose, saving the gold and silver values which had been partially or wholly lost before its adoption, while also producing a product of uniformly high grade. Although Lake copper is best suited for certain uses, and there are other excellent brands not produced electrolytically, the fact remains that electrolytic copper is now the standard of the world, and bids fair to remain such until something akin to a revolution in metallurgy shall give us a refining process better or cheaper. The cost of refining a ton of crude copper by electrolysis varies greatly, ranging from about $10 up to probably nearly $25, with $12 to $14 as the average figures. Unlike smelting, which can usually best be done near the mine to save excessive freight charges on worthless material, electrolytic refining is performed in most cases nearer the consumer than the producer. The extra freight paid on the very small percentage of impurities in blister copper is so very small a fraction of the total transportation charge that this loss is more than offset by the advantages offered by the cheaper labor, cheaper fuel, and better transportation facilities that are found along the Atlantic seaboard in the United States, where a considerable amount of foreign copper is refined, as well as the bulk of the domestic production.

The possibility of electric smelting has long excited the interest of scientists and practical metallurgists. Various laboratory experiments have resulted well, but it is not a matter of record that any electric furnace is in successful commercial operation. Claims have recently been made that refined copper can be produced direct from mattes, or even from ore, by electrolysis. These claims remain to be demonstrated.

# CHAPTER V.

## THE USES OF COPPER.

The three indispensable metals of the present age are iron, copper and zinc. The loss of tin, nickel, lead and aluminum would be a severe blow and work great hardship, and even were we to be deprived of such apparently insignificant metals as antimony, cobalt, manganese and platinum, the industrial world would suffer a loss that would entail very disastrous consequences. The taking away of gold and silver, and that useful thief-taker, mercury, which catches most of the world's gold supply, would reduce the globe's finances to chaos. Iron and copper, however, are the main pillars of the metallic structure, while zinc, in addition to many other virtues, possesses the unique quality of being the only electrically negative metal, and without it, copper, for electrical purposes, would be like a "pair" of scissors with but one blade.

The uses of copper are many, and great industries are dependent upon this metal, which affords direct employment to some hundreds of thousands of persons, mostly skilled workman, and annually adds something like five hundreds of millions of dollars to the wealth of the world. The Stone Ages of humanity were followed by the Bronze Age, in which copper and tin were the only metals used, unless the wearing of a few gold and silver trinkets could be said to establish the use of those metals. The Age of Iron followed that of Bronze, and the Steel Age of the latter half of the Nineteenth century is but a later and higher development of the Iron Age, just as the polished stone weapons of the Neolithic Age of ethnologists indicate a period of adaptation and improvement upon the cruder weapons and implements of an earlier day. While iron and steel are not only holding their own, but gaining ground in phenomenal strides, another metal has arisen to claim at least a portion of the honors of Twentieth century civilization, and copper is the foundation of the Electric Age, just as it was the fundamental metal in the Age of Bronze, some milleniums ago.

Of the many uses of copper, electricity is easily the most important. From a plaything for philosophers, in the times of Franklin and Volta, electricity has become one of the prime factors of the life of the present day, and, unless all signs fail, the uses that we consider multifarious, and the installations that we deem immense, are but the precursors of yet better and greater things, of which we may sometimes dream, and from which unsubstantial fabric the flash of Genius and the fires of Labor will bring forth the perfect fruit, for the use of generations yet unborn. A full enumeration of the electrical uses of copper would require a volume, rather than a few paragraphs in a single chapter. The metal is an integral factor in all electrical installations, and for the transmission of power, light and telegraphic or telephonic impulses, is a necessity. The iron wires of pioneer telegraph and telephone lines are rapidly giving way to copper strands. Iron is low in electrical conductivity, making it an inefficient and costly medium for transmission. It is also subject to rust, and its lack of the ductility which is such a prominent characteristic of copper, causes iron wires to break from winds and sleets that would not injure lines of copper. Iron telegraph and telephone wires are still used to a much larger extent than generally imagined, owing to the cheap initial outlay, but the cost of maintenance and repairs renders it certain that iron must give way, sooner or later, at all points, to copper.

The electric light was the luxury of great cities two decades ago; now it is the necessity of every progressive village of so many as a thousand souls. But a quarter century gone, telephones were a scientific toy to the enlightened, and something uncanny and dangerous to the ignorant. Today a network of wires stretches across the American Continent, and Stockholm, upon the banks of the Malar, has one 'phone for every family of its population. The business man at his desk talks with his broker a thousand miles away. The Calumet & Hecla copper mine, one of the world's greatest properties, has telephones nearly a mile below the earth's surface. Timbuctoo shall have them too, before the century's past, and to the pole that's now our goal, we'll telephone at last.

Only fifteen years ago the electric railway was looked upon by conservative persons as a trumpery sort of experiment, scarcely able to deprive the long-eared mule of his appointed mission as motive power for the American street-car system. But where is the mule to-day? His bones lie whitening upon the veldt of South Africa—British South Africa now—and the street cars know him no more.

Electric heating is yet an experiment, but its day will come. Electricity must play a more and more important part in the world's manufactures, both as a motive power and a reducing agent. In the happy days of the future the struggle of coal barons with rebellious workmen will no longer distract a public desirous of fuel for hearth and workshop. In fifty years, or less, the owners of the waterfalls will be the men on whose devoted heads the vials of wrath will be poured out, for they will furnish the heat and power, and will reap the reward of great riches, with corresponding unpopularity. Great as has been the electrical development of the past two decades—and it really began in earnest only a quarter of a century ago—the future assuredly will discount the past. Power, heat and light that can be summoned by the turning of a switch, or the pressing of a button, will, of a certainty, displace the power that comes from laborious stoking; the heat that comes with delay, and much soot and smell, and leaves ashes behind; and the light that comes of striking many matches, and with the effusion of kerosene that is odoriferous. Electric power is already the cheapest form of energy, where waterfalls are used. Electric light is growing both better and cheaper. Electric heat, while dear for ordinary use, at present, will become cheaper. The use of electricity for power, heat and light must become well-nigh universal, in time.

Next to its electrical uses, copper is most extensively employed in engineering; every modern engine has brass oil-cups; brass and copper tubing is used in many boilers; brass, gun-metal, bronze and composition copper bearings are a necessity. Copper and brass boiler tubes are used in locomotives and other high type boilers, having ability to withstand enormous pressures, and being excellent conductors of heat. Copper tubes are used almost exclusively in marine condensers. Until the era of iron vessels, prudent ship-owners sheathed the hulls of their craft with copper, which kept the bottoms clean. Within the past few years this practice has been renewed, with modern steel steamers, on which it is necessary to plank over the hull below the water line, in order to give a backing for the riveting on of the copper sheets. The loss in speed, and consequent loss in time and fuel, brought about by barnacles gathering on iron and steel bottoms, is very great, and the cost of dry-docking and scraping, with loss of time entailed thereby, is probably considerably greater than the expense of wood-sheathing and coppering iron and steel vessels below the water line. Eventually some method will be devised for the plating of copper directly on the steel bottoms of the boats.

Copper is used extensively in architecture, as roofing for buildings, either in sheets or tile form, and in cornices. For the latter use copper is considerably more costly than galvanized iron, but its freedom from corrosion, and its rich appearance without painting, render it desirable for ornamental cornice work on the better class of buildings. Bronze gates and doors for churches and public buildings are highly ornamental, and the most desirable that can be made. Bronze grille work is frequently used, and its richness and permanence cause it to be regarded favorably. In builders' hardware, brass, bronze and copper locks, knobs, escutcheons, butts, bolts, catches and drawer pulls are in steadily increasing favor and use, and from the superior durability and appearance of copper and its alloys, will continue to displace iron in a greater ratio, as the nations increase in wealth and the standard of living is raised. Brass rods for portieres, curtains and stair carpets are in favor. Brass pipes and faucets, usually nickeled, are used in the best plumbing, for bathrooms and lavatories, on land and sea, and in railroad sleeping-cars. Extensive use is now made of brass rods in devices for window displays and in various mechanisms for exhibiting goods, in retail business places.

The domestic uses of copper and brass are varied. Brass beds and furniture attract by their cleanliness, beauty and durability. Brass or copper lamps, for kerosene oil, are more durable and ornamental than those of glass and other materials, and also far safer. The consumption of high grade brass piping and castings, for gasoliers and electroliers, is enormous, and constantly increasing, displacing the crude iron pipes and castings of the preceding generation. In the kitchen the brazen kettles of earlier days are losing ground. There is no material better fitted for cooking, when carefully cleaned, and none that may cause so much trouble, if neglected.

Within the past few years, copper has been used for roofing passenger coaches of railroads, with good results. The ideal passenger car of the future will have a steel frame, a copper roof, a wooden interior finish with brass fittings, and paper wheels.

Wherever there are waterworks, brass faucets and valves will be found. The consumption of brass for valves is enormous, and for very many uses these valves, while very costly in the larger sizes, are economical in the end.

For more than two thousand years statues have been made of bronze. Iron turns to rust, wood decays, and marble is discolored, but bronze retains the beauty and finish of the sculptor, and is subject to a slight corrosion only, in the course of ages, when buried in the earth. For decorative purposes bronze is used for vases, urns and similar ornamental receptacles.

Copper and its alloys have been employed for coinage from time immemorial. Originally copper was a purely money metal, like gold and silver. and each copper coin, unless debased by the short-sighted cunning of the petty tyrant, oligarchy or democracy of the day, represented upon its face merely the intrinsic worth of the metal contained. The inherent impossibility of keeping three separate metals upon any fixed parity led to the relegation of copper to the status of token money, for the same reason that silver coins were made merely a token money also, by the leading commercial nations of the globe, during the century just passed. The Chinese still give honest values in their brass money, and the experience of Europeans, who require a coolie with a wheelbarrow to carry around the change for a gold sovereign, is typical of what would be the case over the entire world if copper had not been eliminated from the list of purely money metals. The annual consumption of copper for coinage is much greater than would be anticipated by anyone who has not given the matter a little investigation.

The followers of Mars are liberal consumers of copper. The brass cannon, so popular fifty years ago, are now used mainly for firing salutes, ornamenting public squares, and trading to the heathen. Notwithstanding the disuse of the metal for ordnance, except in small salute-guns for yachts, more copper is now used for munitions of war than was ever consumed in the casting of cannon. Brass and copper cartridge cases, cold stamped from tough sheets, are consumed annually to the extent of hundreds of millions, by the world's armies, for machine guns and small arms, and to a scarcely smaller extent by hunters. Hundreds of tons of the best tough metal are consumed annually, merely to make the brass buttons that decorate the uniforms of the world's armies and navies. Brass fittings and buckles for men and horses, brass canteens, drinking cups and cooking utensils, also require much copper. It is probable that copper must give way to aluminum for these latter uses, throughout the world, as aluminum is lighter and tarnishes less easily. The copper exploders, used in every metal mine where modern methods are employed, afford another use, apparently trivial, yet which is one of the scores of minor demands that in the aggregate foot up thousands of tons annually.

In the arts and manufactures copper plays a highly important part. The great vacuum pans of the sugar factories and refineries are made of copper.

There are copper vats in pulp and paper factories. The worms and stills of distilleries are of copper, and the copper brewing kettles in which beer is made are of immense size and numbered by thousands. There is scarcely a manufacture that does not make more or less use of copper or brass, in some one or more of the processes employed. The works and cases of Yankee clocks, now to be found in the most remote corners of the earth, are of brass, as are the gear wheels and pinions of watches and other instruments of precision. The manufacturers of scientific instruments and optical goods are excellent patrons of the brass-founder. From him are obtained the alloyed metal that, under many forms, as sheets, tubes, rods, wires and castings, make up the bulk of the construction of microscopes and telescopes, of surveyor's transits and draughtman's protractors, and of the many strange instruments of marvelous complexity and variety that do human work without the element of human fallibility.

The textile manufacturers use copper rolls for stamping patterns upon calicos and print cloths. Brass platens upon typewriters are used to aid in manifolding. Signs of copper and brass stare at us from every corner of crowded city streets. Copper leaf is used by sign writers and in other ways. Comminuted copper is used for bronzing.

The uses of copper enumerated in the preceding paragraphs of this chapter are for the metal and its metallic alloys. There are alloys, such as nickel-copper, arsenic-copper, aluminum-copper and others, hitherto unmentioned, which are used for a variety of special purposes. In addition to the uses of copper and its metallic alloys, there are highly important utilities for various ores and compounds of the metal. Malachite, when found massive and pure, is a semi-precious stone of great beauty and much in demand for table-tops and interior architecture. Other ores are ground up for pigments, several beautiful shades of green and blue being secured from mixtures having copper ores as bases.

The most important copper mineral, for other uses than the production of metal therefrom by smelting, is sulphate of copper, the common blue vitriol of commerce. This is occasionally found in nature, as chalcanthite, but is almost invariably a product of manufacture. This compound is one of the most important chemical agents known to science and industry. It is a necessity in the electrolytic refining of crude copper. It is a component part of all wet batteries, and as such rings our door-bells, transmits our telegrams, and is the energizing agent that permits the transmission of the human voice over the wires of the telephone. In electro-plating, electrotyping and kindred industries, it is the prime factor. As an insectide it stands without an equal; dilute solutions of sulphate of copper stayed the ravages of the phylloxera when the vineyards of France seemed doomed. It is probable that not less than one hundred thousand tons of copper sulphate, containing a quarter of its weight in metallic copper, is consumed every year in spraying the vines and fruit trees of Europe and America, and thus it may be said that it is to copper that we owe the sparkling wines of France, the peerless American apple, and the blushing peach that reaches perfection on every continent.

The consumption of sulphate of copper is not confined to viticulture and the electrical industries, as it is consumed by the thousands of tons monthly in the textile factories, in the chemical industries, and in manufactures of lines so varied as to make their mere enumeration fatiguing.

The question of substitution of other metals is one that comes up periodically. Aluminum is often mentioned as the metal that is to displace copper almost entirely. There is little likelihood of such a consummation, unless aluminum can be made at a fraction of its present cost. Aluminum is the most common of all metals, being the base of every clay, but it is reduced with great difficulty, and at heavy cost, by electrolysis, but it is a useful metal, with a distinct sphere of its own. Several of its alloys are of much utility, and the pure metal, owing to its lightness, is available in many places where steel and copper are less desirable. Aluminum has fair electrical conductivity, but is not apt to replace copper to any great extent for electrical uses, unless aluminum goes down and copper goes up in cost.

In lines other than electrical copper has many substitutes. These come into use when the metal is high, and go out when the cost of copper falls. Like all other commodities, copper finds its level. High prices encourage substitutions and decrease consumption in other ways, while low prices encourage the substitution of copper for other materials in many places. The true value of copper is, like the true value of all other commodities, the price at which enough metal can be produced, at a fair profit, to supply the world's legitimate requirements at a reasonable price. An era of high prices stimulates production and restricts consumption, with an eventual collapse of prices and trouble to producers. An era of low prices restricts production, stimulates demand and plainly foreshadows future grief for the consumers.

In the next annual issue of this work I hope to add a chapter on the cost of producing copper in various districts. To be of high value such a chapter must contain at least the summaries of costs of many mines in many different districts. The data now at my command, while very full as to some districts, is scanty in other cases, hence I deem it better to withhold figures until securing a sufficient mass of fully authenticated material to warrant generalizations. It may be said, however, in a general way, that the production of copper, as a whole, has always been one of the most profitable of the mining industries, and while net earnings have shown violent fluctuations, the average has been an excellent one. This refers, of course, to the steady producers that work year in and year out, alike in good seasons and in bad. It is probable that in any decade of the past century fully 80 per cent. of the copper product was made at a fair profit. Half of the balance of copper produced would show profits in some years and losses in others. The remaining 10 per cent. would show very heavy losses. The cost of making copper has been under six cents per pound, as in the case of the Quincy mine, in 1894, and has been as high as $4 per pound in the unfortunate histories of other mines. Certain mines securing large values in gold and silver could show costs of less than six cents per pound, by deducting from copper costs the value of the precious metals secured as by-products. In the case of still other properties, such as the

Rio Tinto, where sulphur, and even iron, are secured as by-products, the cost of the copper production is correspondingly reduced. It is probable that the average cost of 75 per cent. of the world's copper production, at the present time, is from 9 to 10 cents per pound. There is no reason to think that the many new producers, of which great things are expected, will be able to reduce this average. It is more probable, indeed, that they will raise the average cost, rather than lower it. The present margin between costs and selling price is too small, considering the capital invested and the risks taken in mining ventures, hence a higher price must come eventually.

The copper industry is facing a bright future. As these lines are written, in October, 1902, the general feeling of producers seems pessimistic. This is not warranted by the existing conditions. There will be many mines lost, of course, but this is inevitable. Merchants fail in the most prosperous years, and people die in the healthiest seasons. Copper mines have failed in the past, and copper mines will fail as long as copper is mined, but the good properties, adequately financed and capably managed, will pull through, beyond the shadow of a doubt. The low prices of the present are operating to weed out the incompetents, and consumption of the metal was never before so great as during the year 1902. Consumption is exceeding production and this will stimulate the price of the metal until the current is again reversed. New uses are found for copper every year, and the established uses are constantly calling for more metal. The electrification of the existing railway mileage would require about six million tons of copper, or ten times the present annual output of the world's mines, and the electric railway mileage of the United States is already sufficient to girdle the globe at the equator. The substitution of electric energy for traction engines is nearly complete, in the case of the urban railway systems. Suburban railroads are experimenting along the same lines, and the ultimate substitution of electricity for steam locomotives, upon all but a small fraction of the railroads of the world, is a consummation almost certain to be reached within the first few decades of this century. Even without this possible, if not probable, demand for copper, the present uses of the metal are sufficient to take care of a greatly increased production.

One hundred years ago the yearly production of copper by the mines of the world was less than 10,000 tons—less than is now made in a single week. Fifty years ago the output was scarcely as much as is now made in a month. In 1881 the production was about 163,000 long tons. In 1889 the output reached 269,000 tons, the market was glutted, and prices fell with a crash. Last year the production was nearly twice as large as in 1889, and the great copper surplus, of which so much has been heard, was never estimated as more than four to five months' supply, in the highest figures of the many guesses put forth.

# CHAPTER VI.

## GLOSSARY OF MINING TERMS.

In this section of the Copper Handbook the glossary, first appearing in the 1902 Edition, has been materially amplified, and will be found to give nearly all of the terms used in copper mining, milling and smelting.

**ACID.** An acid rock is one in which bases are combined with acids, forming salts. The antithesis of basic.

**ADIT.** A tunnel. A mine opening, driven from the surface into a hill or mountain, on practically a horizontal plane, only enough rise being allowed to provide for natural drainage and to allow the easy removal of cars bringing rock from the breast of the working. An adit can be driven only where the surface is mountainous or quite hilly.

**ADOBE.** Sun-dried brick.

**AIR-BLAST.** A violent explosion, caused by the escape of air compressed by the settling of the upper workings of a deep mine.

**AIR COMPRESSOR.** A machine for condensing air to a pressure sufficient to actuate machinery, when delivered underground or elsewhere at a considerable distance.

**AIR-DOORS.** Owing to strong currents of air frequently found in the depths of mines, it is sometimes necessary to build a little chamber in a drift connecting two shafts, with a door at either end, to prevent the strong air currents blowing out the lamps and candles of the miners.

**AIR-DRILL.** A power drill operated by compressed air.

**AIR-SHAFT.** A shaft sunk solely to provide ventilation for deep workings, or else an old shaft kept open solely to furnish air to the mine. Nature provides a means of ventilating even very deep mines. Two shafts, one of which is sunk on slightly higher ground than the other, will provide natural ventilation underground as soon as connected by a drift. The longer shaft becomes a chimney and the shorter an inverted syphon, down which the air is sucked with great force.

**ALKALI.** An alkali is a lye—the opposite of an acid.

**ALLOY.** Two or more metals united mechanically, but not chemically, by fusion.

**ALLUVIUM.** Soil or broken rock deposited by the action of water.

**ALTERED.** A rock that has undergone changes in its chemical and mineralogical structure since its original deposition.

**ALUMINOUS.** A rock having aluminum as a base or prominent constituent element.

**AMALGAM.** A union of mercury with other metals, such as gold, silver or copper. Mercury will not amalgamate with iron.

**AMALGAMATION.** The process of uniting gold, silver or copper with mercury. The quicksilver is expelled later by heat and recovered for further use.

**AMORPHOUS.** Without form.

**AMYGDALOID.** A trap rock, of igneous origin and frequently of highly complex structure, the name coming from the little pits or amygdules of softer rock-material found therein. In the Lake Superior copper district the copper-bearing amygdaloids frequently show the native copper in the amygdules left by the leaching out of the softer rock originally contained therein.

**AMYGDALOIDAL.** Of the nature of or akin to an amygdaloid. Word used in England, in place of amygdaloid.

**ANALYSIS.** A complete chemical test of any given substance.

**ANHYDROUS.** Devoid of water.

**ANTICLINAL.** A fold of rock-strata bulging upward, in saddle-shape. The reverse, geologically, of synclinal.

**ANTIMONIDE.** An ore of any metal or metals chemically united with antimony.

**APEX.** That part of an ore vein at or nearest surface. Usually requires opposing experts and several lawsuits to determine. In case of litigation the apex is usually owned by the litigant having the most money.

**APICES.** Apexes.

**ARASTRA.** A Chilean mill. A circular trough, in which broken ore is pulverised by a revolving wheel or mill stone.

**ARENACEOUS.** Of a sandy nature.

**ARGENTIFEROUS.** Silver-bearing.

**ARGILLACEOUS.** Of a clayey nature.

**ARROBA.** A weight of varying heft. Spanish, 25.36 pounds avoirdupois. Portuguese, 32.38 pounds.

**ARSENIDE.** An ore of any metal, or metals, with which arsenic is chemically united.

**ARSENOPYRITE.** An ore of any metal or metals with which arsenic and sulphur are chemically united.

**ASSAY.** A chemical test of ore or metal to determine its exact content and value in any given metal or metals.

**ASSESSMENT WORK.** The amount of work required annually by the United States government, from the holders of an unpatented mining claim.

**ATTLE.** Cornish term for waste rock.

**AURIFEROUS.** Gold-bearing.

**AUXILIARY.** An auxiliary engine or machine is one kept in reserve, for use when the principal machine is idle for repairs or other reasons.

**AVERAGE PRODUCE.** Cornish term for percentage of copper in ore.

**BACK.** The roof of rock above any mine opening driven on a horizontal plane.

**BAD AIR.** Air in which miners cannot work, due to powder fumes, noxious gases or insufficient ventilation.

**BAL.** Cornish name for a mine.

**BALANCE BOB.** A counterweight for pump rods.

**BALL HEAD.** A steam stamp, so called because invented by a man named Ball.

**BALL STAMP.** A Ball head.

**BARILLA DE COBRE.** Spanish term for native copper, dressed, but unsmelted. Equivalent to the "mineral" of Lake Superior mines.

**BARREL WORK.** Copper in small masses, detached from its rock-matrices at the rock-house, and shipped in barrels direct to the smelter. Small masses, of a size to put in barrels.

**BARROW.** A wheelbarrow; also same as burrow.

**BARTLETT.** A Bartlett concentrating table.

**BASALT.** A trappean rock.

**BASIC.** A rock in which metals are combined with alkalies, such as potassium, sodium, etc.

**BASIN.** A synclinal; a trough in the earth's surface.

**BATTERY.** A set of gravity stamps, usually five in number, but sometimes less.

**BEARING.** The bearing of a mineral outcrop is its strike.

**BEATING AWAY.** To cut down or stope a mineral body.

**BED.** A stratified rock formation. Used in some mineral districts to mean veins or lodes lying horizontally, or approximately so.

**BED-ROCK.** The solid rock as differentiated from loose or surface rock. The ledge.

**BELLS.** Signals for lowering and hoisting the bucket, skip or cage in a shaft are usually given by bells, the number of strokes indicating the nature of the load, the place for landing, etc.

**BIT.** A steel drill. A short hollow cylinder of soft steel, used in diamond drilling. The diamonds are set around the inner and outer edges of the bottom of the bit and cut away the most refractory rocks when the bit is rotated.

**BLACK COPPER.** Copper partly smelted, but containing impurities requiring refining.

**BLACK JACK.** Zinc blende.

**BLAST.** To explode dynamite or black powder. Air forced into a furnace to aid in reducing the ore charge.

**BLASTED.** A miner that has been blasted is one who has been injured by the explosion of a charge of dynamite or gunpowder.

**BLASTING.** The breaking of rock by means of high explosives inserted in holes bored in the rock for the purpose.

**BLENDE.** Zinc blende.

**BLIND DRIFT.** A drift connected with the other workings of the mine at one end only. A cul de sac.

**BLIND LODE.** A lode that does not come to surface.

**BLIND SHAFT.** A shaft not coming to surface. A winze.

**BLISTER COPPER.** Copper of 96% to 99% pure.

**BLOCKHOLE.** A hole for explosives drilled in a mass of ore or rock already broken from the vein, but too large to handle.

**BLOCKING OUT.** To open the ore in a mine so that it can be won merely by stoping.

**BLOSSOM.** An outcrop of an ore body altered by weathering.

**BLOWER.** A fan used to force air into a mine.

**BLOWING IN.** A furnace or smelter is blown in when charged and the process of ore reduction begun by fire.

**BOILING SHAFT.** A sand-shaft in which quicksand and water boil up from the bottom.

**BONNET.** The cover or roof of a cage.

**BORE HOLE.** A drill hole bored for test purposes.

**BORT.** A form of crystallized carbon between the diamond and the black diamond.

**BORTZ.** Bort.

**BOTTOMS.** Impure copper formed below the matte, in matting copper ores.

**BOULDERS.** Detached masses of rock, rounded by attrition, usually found at or near the surface, in alluvial deposits lying above stratified rocks.

**BOX CANON.** A canyon closed at one end.

**BRANCH.** A vein branching off from the main ore body.

**BRATTICE.** A screen for the regulation of air currents in a mine opening.

**BREAST.** The face or working end of a drift, stope or adit.

**BRECCIA.** A conglomerate rock, in which angular fragments of rock are cemented together.

**BRECCIATED.** A rock stratum made up of sharply broken fragments, partially or wholly cemented together.

**BROKEN.** A vein is broken when lacking clearly defined walls or characteristics of regularity.

**BROKEN GROUND.** Rock strata where the walls are poorly defined and the general formation unsettled.

**BROOD.** Cornish for waste ore, such as mundic or zinc blende, where found in connection with copper ores.

**BUCKET.** A kibble. An iron or steel bucket used for hoisting in a mine. In a vertical shaft a bucket swings free in ascending and descending, but in an incline shaft the bucket runs on a skidway of plank or timbers, or else rides a trolley cable.

**BUDDLE.** A conical table on which ore is dressed. Machine and name both growing obsolete.

**BULKHEAD.** A wooden or masonry partition walling off a mine opening.

**BULLION.** Refined gold or silver before coining. Sometimes erroneously applied to copper.

**BULLION BARS.** Unrefined gold and silver secured by melting the precious metals precipitated to the bottom of the tank in the electrolytic refining of argentiferous and auriferous copper anodes.

**BUNCH.** A pocket exceptionally rich in mineral.

**BUNCHY.** An ore body given to considerable variations in width or values, or both.

**BURDEN.** Overburden.

**BURROW.** See rock burrow.

**CABLE.** The steel wire rope used in shafts for hoisting buckets, skips or cages.

**CAGE.** An elevator used in vertical shafts for hoisting mineral and for lowering men, timber, etc.

**CAKES.** Copper cast in cakes.

**CALCAREOUS.** Of a limey nature.

**CALCINE.** To drive off sulphur or other volatile constituents of an ore by heating.

**CALCITE.** Crystals of calcium carbonate.

**CAM.** A curved tooth, fixed on a shaft, for lifting the pistons of gravity stamps.

**CAMP.** A mining town.

**CANON.** (pronounced canyon). A deep gorge with precipitous walls.

**CANYON.** A canon.

**CAP.** The top piece of a framed set of mine timbers: copper caps containing fulminate of mercury, used to explode dynamite in blasting rock. The fuse is cut to proper length, one end placed in the cap, and the cap inserted in a pasty dynamite cartridge. The free end of the fuse is fired, and the explosion follows quickly or tardily, as the fuse is cut long or short.

**CAPPING.** The rock or other ground overlying the mineral body of a mine.

**CAP-ROCK.** Capping.

**CAPTAIN.** A man in charge of mining work is termed a captain. The mining captain is the executive officer underground.

**CARBONACEOUS.** Of a coal-like nature.

**CARBONATE.** An ore of any metal or metals with which carbon and oxygen are chemically united.

**CARBONIFEROUS.** Rocks of the geological ages usually associated with coal measures.

**CARGA.** A Mexican weight equalling 300 pounds avoirdupois.

**CARTRIDGE.** Dynamite put up in cylindrical cases of oiled paper to fit the holes bored by the drills.

**CASING.** The wooden lining of a shaft; an iron pipe put down outside of a diamond drill hole when passing through soft or broken ground, to prevent the hole becoming clogged by matter intruding from outside.

**CASTING COPPER.** Refined copper better suited for casting into various forms than for drawing into wires or rolling into sheets.

**CAVE.** A natural opening or "vug" in a rock formation; the partial or complete falling-in of a mine.

**CAVING SYSTEM.** A plan of mining, by which the worked out upper levels and surface are allowed to subside gradually as the mine workings are deepened.

**CEMENT COPPER.** The impure metal obtained from ores by leaching processes.

**CERRO.** Spanish for a hill showing rock outcrops.

**CHAMBER.** A large stope.

**CHAPEAU DE FER.** French for gossan or iron hat.

**CHARGE.** The amount of ore, flux and fuel required for one filling of a furnace.

**CHIMNEY.** An ore chute.

**CHERT.** A coarse flint containing calcium.

**CHILEAN MILL.** An arastra.

**CHILE BARS.** Bars of Chilean blister copper, weighing about 200 pounds each.

**CHLORIDE.** The ore of any metal or metals united chemically with chlorine.

**CHURN DRILL.** A drill having a churning motion, used for boring test-holes, or wells.

**CHUTE.** A section of a lode or vein differing by being much richer or leaner than the average.

**CLACK.** A pump valve.

**CLAIM.** Public land staked off and claimed by a prospector or miner. Size of claims varies in different countries.

**CLAY COURSE.** A seam of clay between vein and wall.

**CLAY SLATE.** An argillaceous slate.

**CLEAN-UP.** The cleaning up of accumulated ore or metal in a mill or smelter.

**CLEAVAGE.** The parting of rock along more or less regular lines of least resistance.

**COARSE JIGS.** The jigs used to handle the heavier grades of ore or metal.

**COARSE METAL.** Matte resulting from the first smelting.

**COBBING.** Breaking masses of ore into lumps by hand hammers.

**COLLAR.** The top of a shaft—the surface timbering of a shaft.

**COMPANY ACCOUNT.** Miners and other underground employes working on fixed wages per shift or month are usually called "company 'count men" to distinguish them from miners working on contract.

**COMPARTMENT.** Mining shafts are usually divided into two or more compartments, separated by framed timbers and planking.

**CONCENTRATES.** The concentrated ore or metal, after elimination of gangue rock.

**CONCENTRATION.** The process of separating native metal or ore from its gangue of worthless rock.

**CONCENTRATING TABLES.** Concentrators.

**CONCENTRATOR.** A plant where ores are concentrated; a jig. A machine for separating ore or metal from gangue-rock, the process usually employing a rocking or oscillating motion, aided by jets of water, whereby the worthless gangue is driven off and the heavier mineral retained by specific gravity.

**CONDUCTIVITY.** Electrical conductivity is measured by the resistance offered to the passage of an electrical current.

**CONGLOMERATE.** A pudding-stone rock formed by deposition of rock particles on old sea-beds, afterward covered by other rock strata.

**CONSTRUCTION ACCOUNT.** Many of the Lake Superior copper mines summarize their finances so that the cost of operation is divided into two classes, one being for general working expenses and the other for construction account. The latter includes new buildings and machinery on surface, and frequently new mine openings. In effect the construction account of a mine is like the stock account of a merchandise firm, and sometimes, like charity, "covers a multitude of sins."

**CONTACT VEIN.** A mineral body found between two unlike rock strata.

**CONTOUR.** The outline or configuration of any given tract.

**CONTRACT.** Many miners work on contract, agreeing to sink, drift or stope at a fixed price per running foot, or per fathom. These are known as contract-miners, and are usually the more skilled workmen.

**COPPER ORE.** See detailed descriptions of copper ores and copper-bearing minerals in chapter on chemistry and mineralogy.

**CORE.** A drill core.

**CORNISH PUMP.** A form of mine pump actuated by long rods reaching from surface down the shafts.

**CORNISH STAMP.** A gravity stamp, in which the heads are raised by cams and dropped by gravity.

**COST BOOK SYSTEM.** A plan of mine operation, used in Cornwall only, by which shares are subject to unlimited assessment. A sort of unlimited partnership.

**COSTEANING.** Developing. Proving an ore body by trenching across its outcrop at approximately a right angle.

**COUNTERBALANCE.** Hoisting plants are usually worked in counterbalance for deep shafts. The weight of the descending cage or skip is used to partially offset the weight of the cage or skip ascending.

**COUNTER VEIN.** A cross vein, running at approximately right angles to the main ore body.

**COUNTRY ROCK.** The predominant rock form of the district.

**COURSE.** The direction or strike of a mineral body.

**CRAB.** A hand winch.

**CREEPING.** The movement caused in mines by the pressure of superincumbent and adjacent rock masses.

**CROPPINGS.** Outcrops.

**CROSS COURSE.** An intersecting vein.

**CROSSCUT.** An opening similar to a drift, except that the crosscut is sent at approximately right angles to the formation, while a drift follows the trend of the lode or vein.

**CRUCIBLE.** A vessel of refractory material, used to contain ores and metals for assaying or smelting.

**CRUSHER.** A rock-crusher.

**CRYSTALLIZED.** Having plainly defined crystals.

**CRYSTALS.** Geometrical forms, with plane faces, of infinite variety, assumed by the majority of minerals.

**CUPOLA.** A furnace in a smelter.

**CUPRIFEROUS.** Copper-bearing.

**CUTTING DOWN.** When a shaft is enlarged, work begins at the top, and the work of enlargement is called cutting down.

**CWT.** A hundredweight, of 112 pounds avoirdupois.

**DAM.** A masonry barrier, built underground, to hold back water.

**DATUM LEVEL.** The level (usually sea-level or mean level of nearest considerable body of water) from which altitudes are measured in surveys.

**DEAD ROASTING.** Sulphide ores are dead roasted when all the sulphur possible to drive off by roasting has been eliminated.

**DEAD WORK.** The opening of new shafts, drifts and winzes, preliminary to the stoping of the mineral bodies.

**DEBRIS.** Broken down rock material.

**DECOMPOSED.** Rock or ore broken down by elemental action.

**DECREPITATE.** To break into fragments with violence, under the blow-pipe or great heat.

**DENUDATION.** The uncovering of rock strata by the weathering of wind or water, or both.

**DEPOSIT.** A term, loosely used, meaning a mineral body.

**DERRICK.** A mast, freely rotatable, carrying a boom or yard-arm, at the end of which is a sheave wheel. Used in mining mainly for open pit work.

**DESSICATION.** The drying out of water for any given substance.

**DETRITUS.** Debris. Broken down rock.

**DEVELOPMENT WORK.** Dead work.

**DIAMOND DRILL.** A machine for boring holes in rocks, taking its name from the black diamonds or bortz used to form cutting edges on the inner and outer edges of the hollow cylindrical bit.

**DIE.** The iron block in the mortar, on which the ore is fed for crushing under the stamp.

**DIORITE.** Greenstone. A crystalline spathic hornblende.

**DIP.** The angle at which a lode or vein descends from the earth's surface.

**DIP COMPASS.** A compass having the needle fixed to swing in a vertical plane.

**DIRT.** Frequently used to describe the ore broken underground.

**DISSEMINATED ORE.** Ore found scattered through a gangue of valueless rock.

**DISTURBED.** An ore body is disturbed when lacking defined walls and settled character.

**DOLLY.** A crude prospecting stamp, set on a spring pole.

**DOLOMITE.** Magnesian limestone; carbonate of calcium and magnesium.

**DONKEY HOIST.** A small auxiliary hoisting engine, usually operated underground and actuated by compressed air; or else used for preliminary work at new shafts or exploring pits.

**DOWNCAST.** A shaft having a downward air current.

**DRAFTAGE.** An arbitrary allowance claimed by English smelters to cover loss of weight in transport.

**DRESSING.** Separating ore from gangue rock by hand or machinery.

**DRESSING FLOOR.** A floor or dirt surface where ore is dressed by cobbing and other hand work.

**DRIFT.** A horizontal opening in a mine, following the direction of the lode or vein; loose alluvial matter, such as sand, pebbles and boulders.

**DRIFT COPPER.** Native copper found in alluvium far from its original rock matrice, whence carried by glaciers.

**DRIFTING.** Opening drifts. Driving.

**DRILL.** A steel bar for boring in rock, having a single sharp cutting face, or two cutting faces crossed at right angles.

**DRILL-CORE.** As the bit of a diamond drill is hollow, solid, cylindrical cores of rock are cut by its operation. These are raised to surface and form a valuable permanent record of the strata through which the drill has passed.

**DRILL HOLE.** A hole bored by a drill.

**DRIVING.** Drifting.

**DROP SHAFT.** A shaft, usually of heavy framing, sunk by weight, through sand or similar material.

**DRUM.** The cylinder of a hoisting engine, around which the cable winds.

**DRUSE.** A vug.

**DUCTILE.** That which is capable of being extended in length by tension.

**DUCTILITY.** The capacity of a metal to elongate, when under pull from the ends, without cracking or breaking.

**DUMP.** A place for dumping rock taken from a mine. An ore-dump contains good mineral, and a waste-dump the worthless rock hoisted from underground.

**DYKE.** A fissure in the rock formation, usually transverse, filled with igneous matter. When mineralized, dykes are called cross or counter veins.

**DYNAMITE.** Nitro-glycerine absorbed by wood pulp, infusorial earth, or some similar article to render it safer in use.

**EISENER HUT.** German for Iron Hat or Gossan.

**ELECTRIC DRILL.** A power drill operated by an electric current.

**ELECTROLYTE.** The solution in which electrolytic separation of metals is carried on.

**ELECTROLYSIS.** The separation and redeposition of metals by electrolytic action.

**ELECTROLYTIC.** Term applied to copper means copper gained from impure metal by electrical decomposition and redeposition, whereby the copper is taken from an impure bar and redeposited in a pure form at the opposite pole of the battery, while other metals are precipitated to the bottom of the tank in which this work is done.

**ELVAN.** Cornish name for the dyke rocks of Cornwall, usually greenstone or porphyry.

**EROSION.** The wearing away of surface masses of rock and soil by the elements and by glacial action.

**ERUPTIVE.** Rock matter supposed to have been deposited in molten form by volcanic action.

**ESCARPMENT.** A rock wall, nearly or quite vertical.

**EXFOLIATION.** The separation of thin leaf-like layers from the main body.

**EXPLODERS.** Fulminating caps.

**FACE.** The breast of a drift. A face of ore is the ore shown at the working end of a drift or stope.

**FAHLBAND.** A banded crystalline rock, carrying finely disseminated sulphide ores.

**FALL OF GROUND.** Rock falling from the roof into a mine opening.

**FALSE SET.** A temporary set of timber.

**FAN.** A device used to force air into a mine.

**FATHOM.** Six feet. In stoping, a fathom is a cube of six feet.

**FAULT.** Dislocation of a rock stratum by which continuity is lost.

**FEE.** The ownership of land in fee-simple.

**FEE-OWNER.** The owner of land in fee-simple.

**FEEDER.** A branch ore vein.

**FERRUGINOUS.** Carrying iron.

**FILLING.** Allowing a mine to fill with water. Occupying old stopes or chambers with waste rock.

**FINES.** The finer ores or metals saved in concentrating processes.

**FINISHER JIGS.** The jigs used to save the fine ores or metals in a concentrator or stampmill.

**FIRE.** The miner's warning cry when a blast is to be set off, is "fire."

**FISSILE.** That which may be easily split.

**FISSURE.** Rock matter foreign in nature to the walls on either side—evidently deposited at a later date geologically, in a crack in the original rock.

**FISSURE VEIN.** A fissure, containing ore, usually disseminated in a worthless gangue differing in nature from the country rock in which the fissure occurs.

**FLAKE COPPER.** Very fine scales of native copper.

**FLEET-GEAR.** A compensating device for taking up slack and paying out rope where a hoisting system is worked in counterbalance. Several turns of the cable are taken around each drum of the hoist, and the bight of the cable is carried to the rear and around a large sheave-wheel lying horizontally and traveling on trunnions, allowing the taking up or paying out of the cable.

**FLOAT COPPER.** Drift copper.

**FLOOR.** The floor of a drift or other horizontal mine opening; the underlying rock stratum.

**FLOUR COPPER.** Very fine native copper that floats on water and is very difficult to save in milling.

**FLUCCAN.** A seam of clay, found in ore bodies, or, more frequently, between the ore and walls of country rock.

**FLUKAN.** Fluccan.

**FLUME.** A launder or pipe line for carrying water.

**FLUX.** Any mineral or ore used in the furnace to aid in fusing the gangue rock and worthless elements, which combine with the flux to form slag.

**FOLIATED.** Having a laminated structure.

**FOOT.** The foot-wall.

**FOOT-WALL.** The foot. The stratum of rock underlying an inclined mineral lode or vein.

**FORKING.** Pumping water from a mine.

**FORMATION.** A term used to imply the general geological conditions of a given district.

**FOSSICKING.** Extracting metal or ore from old mines or waste burrows.

**FRACTURE.** A break.

**FREE.** A metal is free when virgin or native, and not combined chemically with any other element.

**FREE-MILLING.** A metal or ore that is readily separated from its accompanying rock by mechanical means.

**FRIABLE.** Easily crushed to a powder.

**FURNACE.** An oven for the smelting of ore.

**FUSE.** A cotton cord with a gunpowder core, so made as to carry fire to an explosive placed for use.

**FUSIBLE.** That which can be melted.

**FUSION.** Melting. Alloying metals while liquid, through heat.

**GABBRO.** A rock composed mainly of plagioclase feldspar.

**GAD.** A small wedge or chisel.

**GALLERY.** A drift.

**GANGUE.** The particles of foreign rock matter adhering to disseminated ores or native metal; the gangue rock is mechanically and not chemically united with the ore or metal.

**GASH VEIN.** A shallow fissure vein, usually wide at surface and rapidly narrowing to extinction.

**GEODE.** A hollow nodule of rock.

**GEOLOGY.** The science of the earth.

**GIANT POWDER.** Dynamite.

**GLACIATION.** The erosive effect produced by glaciers.

**GLANCE.** Any metallic sulphide showing a bright, shining surface.

**G. M. B.** "Good Merchantable Brands"—an English grade of refined copper.

**GNEISS.** A banded, slaty granite.

**GOB.** Mud above a mine. Refuse in worked-out openings.

**GOPHERING.** Prospecting work confined to digging shallow pits or starting adits. Term used from similarity of this work to the crooked little holes dug in the soil by gophers.

**GOSSAN.** Iron Hat. A rock capping, usually quartzose, showing reddish-brown iron stains, from decomposed iron pyrites. Frequently found overlying sulphide ores of copper.

**GRADE.** The percentage or value, when applied to ore bodies and partly refined metals.

**GRANITE.** A dense, granular rock, composed of varying aggregates of quartz, feldspar and mica.

**GRANULATED.** In the form of grains.

**GRASS ROOTS.** At surface.

**GRAVITY STAMP.** A stamp, usually set in batteries of five, in which the piston is raised by a cam, the stamp crushing the charge in the mortar by its weight when allowed to fall.

**GREENSTONE.** Diorite, or gabbro.

**GRIZZLY.** A grating of heavy iron or steel bars, through which the smaller pieces of rock or ore fall.

**GROSS TON.** A long ton of 2,240 pounds avoirdupois.

**GROUNDSILL.** The bed-piece of a set of mine timbers.

**GUIDES.** Perpendicular wooden stringers for guiding cages in vertical shafts.

**GUT.** To rob.

**HADE.** (American). Dip of a vein from the zenith. (English). Dip of a vein from the horizon. Take your choice.

**HALVAN.** Cornish for refuse copper ore.

**HANGING.** The hanging-wall; the stratum of rock overlying an inclined mineral lode or vein.

**HARDHEAD.** A lump of partly smelted ore, carrying high percentages of refractory elements, such as iron, antimony and arsenic.

**HAT.** The capping of a mineral body.

**HAULAGE PLANT.** A mechanical installation for the underground tramming of rock, operated by ropes, compressed air or electricity.

**HEAD.** Water pressure.

**HEADGEAR.** A building, or framework, fitted with sheaves, over the mouth of a shaft.

**HEAP-ROASTING.** Burning the sulphur out of ores piled in heaps with a small amount of wood or other fuel.

**HEAVE.** A fault. The rolling out of line of dip by a lode in making depth.

**HEAVING.** Rolling.

**HECTARE.** A metric measure equalling 2.471 acres.

**HOIST.** An engine for hoisting, the rope, as raised, being coiled around a drum.

**HOISTER.** A hoist.

**HOLE.** Any opening in the ground. More especially a hole drilled for explosives.

**HOLING THROUGH.** A drift or other mine opening is holed through when a connection is made between two separate ends working toward each other.

**HORIZON.** The sky-line, commonly used in the sense of absolutely flat, as shown by a spirit level. Geologically, all rock strata of the same geological period.

**HORSE.** An intrusion of country rock into a mineral body. Sometimes synonymous with dyke.

**HORSE-WHIM.** A windlass operated by horse-power.

**HUEL.** Cornish for mine. Commonly spelled wheal.

**HUNGRY.** Nearly or quite barren of mineral value.

**HUNTINGTON MILL.** An improved Chilean mill.

**HYDRATED.** Containing water of crystallization.

**HYDRO-METALLURGY.** The reduction of ores by wet processes.

**HYDROUS.** Containing water.

**IGNEOUS.** Rocks of volcanic origin.

**IMPREGNATED.** Containing ore. Properly used in referring to country rock carrying mineral similar to that in the vein.

**IN PLACE.** Rock matter in the position where deposited by nature.

**IN SITU.** In place.

**INCH.** See Miner's Inch.

**INCLINATION.** The dip of a vein from the horizon measured in degrees.

**INCLINE SHAFT.** A shaft sunk at any angle with the horizon under 90°.

**INCRUSTATION.** A solidified coating, usually crystallized.

**INFILTRATION.** The deposition of mineral matter from percolating water.

**INGOT.** A mass of metal cast in a peculiarly formed mold; applied only to gold, silver or copper. Iron is cast in pigs.

**INTAKE.** The opening for water to enter a pipe or flume.

**IRIDESCENT.** Showing the colors of the rainbow.

**IRON HAT.** Gossan.

**JIG.** A machine for concentrating ore or mineral by means of oscillatory or vibratory motion, aided by jets of water, separation of the ore from its gangue being effected by the greater specific gravity of the former.

**JIGGER.** A crude jig.

**JIGGING.** Concentrating ore by the use of a jig.

**JUMPER.** A churn drill.

**JUNCTION.** The uniting point.

**KEWEENAWAN.** Pertaining to or of the Keweenaw formation, in which the Lake Superior copper mines are opened.

**KIBBLE.** A bucket used for hoisting material in a shaft.

**KILLAS.** Clay slate or shale.

**KILOGRAM.** A metric weight of 2.2046 pounds.

**KILOMETER.** A measure of distance equalling 0.621376 miles.

**KINDLY.** Appearance of rock carrying or promising to carry good mineral values.

**LADDER ROAD.** A ladderway.

**LADDERWAY.** The series of ladders giving ingress and egress to a mine shaft; the compartment in which the ladders are.

**LAGGING.** Timber, usually of small diameter, placed over the cap-timbers of incline shafts and drifts, to prevent damage from falling rock.

**LAMINAE.** Thin plates.

**LANDER.** The man at the mouth of the shaft, who receives signals from below, and attends to the unloading of rock sent up in buckets, skips or cages.

**LAUNDER.** A wooden flume or sluice, used to convey water, or tailings held in solution in water.

**LAVA.** Rock formed by flows from volcanoes.

**LEACH.** To dissolve minerals from ore by water.

**LEACHING.** Lixiviating ores.

**LEAD (leed).** A mineral body.

**LEDGE.** The solid rock where encountered at or nearest surface.

**LEG-PIECE.** An upright timber supporting the cap of a timber set.

**LEGS.** The side pieces of a set of timber.

**LENSE.** An ore body of lenticular form.

**LENTICULAR.** Having the shape of a double convex lense.

**LEVEL.** A horizontal opening in a mine. Levels are commonly opened at stated intervals as depth is gained—usually at 100 feet in modern mining practice. The word "level" is frequently used interchangeably with the word drift, but is more comprehensive. Both drifts and crosscuts may be opened on a level, but a crosscut is not a level.

**LIGNEOUS.** Of a woody nature.

**LIMESTONE.** Calcium carbonate.

**LIXIVIATION.** The process of leaching out mineral values from ores.

**LODE.** A stratified rock bed carrying mineral values.

**LONG TON.** A gross ton of 2,240 pounds avordupois.

**MAGMA.** Gangue. Rock material carrying ores.

**MALLEABLE.** Capable of changing form, without breaking, under a hammer.

**MAN-CAR.** A skip-truck having tiers of circus seats, used for carrying miners to and from work in mines operating inclined shafts.

**MAN-ENGINE.** An appliance for raising and lowering miners in deep incline shafts. Consists essentially of two long beams, worked in counter-balance and having platforms at stated intervals.

**MASS.** A solid chunk of native metal.

**MASSIVE.** Rock without defined lines of cleavage.

**MATRICE.** The rock surrounding an imbedded object, such as a nugget or mass of native copper.

**MATRIX.** Matrice.

**MATTE.** Regulus. A product between copper ore and blister copper, varying greatly in the percentage of metal contained. Is obtained by roasting out more or less sulphur from sulphide copper ores.

**MATTING.** The process of converting sulphide ores into matte.

**MESA.** Spanish for a tableland or plateau.

**MESH.** The size of openings in a screen.

**METALLIFEROUS.** Carrying metal.

**METALLURGY.** Science and practice of reducing metals from ores and minerals.

**METAMORPHIC.** When said of minerals refers to a rock that has undergone structural and chemical changes after its original formation.

**METRE.** A linear measure equalling 39.37 inches.

**METRIC TON.** A weight of 2204.6 pounds avordupois.

**MILLING.** Dressing ore in a mill; also running ore in a mine through a winze for loading into tram-cars or wheelbarrows on a lower level than the one where broken.

**MILL RUN.** A test of the mineral contents of rock or ore by actual milling.

**MINE.** An open pit, or underground opening or openings from which mineral values are extracted.

**MINER.** In strict construction, the man that does the drilling and blasting in a mine. In a broader sense, all men working underground.

**MINERAL.** Ore, or rock containing metal. In the Lake Superior district the term mineral has a special use, being employed to designate the native copper, with its adhering gangue of amygdaloid or conglomerate rock, as it comes from the mill, before sending to the smelter.

**MINERAL BELT.** The mineralized territory in a given formation or district.

**MINERAL DE COBRE.** Copper matte.

**MINERALOGY.** The science of minerals.

**MINERAL RIGHTS.** The ownership of the rights to mine under the surface of land. Mineral rights are sometimes reserved in selling the surface of land, in some districts.

**MINER'S INCH.** The amount of water that will flow through an opening one inch square under a six-inch head, which is 2,274 cubic feet in 24 hours, or 94¾ cubic feet per hour, equal to 665 wine gallons, or 593 imperial gallons hourly.

**MISSED HOLE.** A drill hole, charged with explosives which fail to be set off by the fulminating cap.

**MOIL.** A steel bar, like a drill, except that it is sharpened to a point instead of having a cutting face.

**MOLDS.** Copper cast in molds.

**MORAINE.** A mass of boulders and detrital material marking the limits of a former glacier.

**MORTAR.** An assayer's mortar in which rock or ore is crushed with a pestle; a mortar box.

**MORTAR BOX.** The iron box under the stamps, into which ore or rock is fed for crushing.

**MUCKER.** A trammer.

**MUNDIC.** Pyrite; sulphide of iron.

**NATIVE.** A virgin metal—not an ore.

**NON-CONFORMABLE.** Rock strata evidently not originally associated in the position now occupied.

**NUGGET.** A lump of native metal. Term usually applied to gold.

**OPEN-CAST.** Working a mine as a quarry, without underground openings.

**OPEN CUT.** A mine worked open-cast.

**ORE.** A chemical union of one or more metallic elements with other elements, usually non-metallic, of which oxygen, carbon and sulphur are the most frequent. For the various ores of copper, see chapter on chemistry and mineralogy.

**ORE CAR.** A mine car for carrying ore or waste rock.

**ORE DUMP.** See Dump.

**ORTHOCLOSE.** Silicate of potassium and aluminum. An acid feldspar.

**OUTCROP.** The ledge of a lode or vein that is exposed on the surface of the earth.

**OUTLIER.** An isolated rock or group of rocks lying at a distance from the main body, and separated therefrom, on the surface of the earth, by a different rock formation.

**OUTPUT.** Production.

**OVERBURDEN.** Superincumbent material, usually drift or alluvium.

**OVERHAND STOPING.** Removing ore in ascending steps.

**OXIDATION.** Process of conversion of metals or ores into oxides by weathering.

**OXIDE.** An ore of any metal or metals chemically united with oxygen.

**OXIDIZED.** United with oxygen. Many minerals and most metals oxidize with greater or less rapidity when exposed to air or water.

**PARE.** Cornish for a gang or shift of miners.

**PARTING.** The separation of two or more metals mechanically admixed, by electrolysis, cupellation, use of acids or other chemical or metallurgical processes.

**PASS.** A winze.

**PATENTED.** A mining claim is patented when the government executes a deed or patent to the holder.

**PENTHOUSE.** A shed-roof erected in the bottom of a shaft, when sinking, to protect miners from accidental fall of rock, timber or tools from above.

**PENTICE.** An erroneous spelling of penthouse.

**PEROXIDE.** The oxide of any metal containing the greatest proportion of oxygen.

**PERPENDICULAR SHAFT.** A shaft sunk vertically.

**PERTENENCIA.** One mineral claim in Mexico; area, one hectare, or 2,471 acres.

**PETERING.** Pinching.

**PETER OUT.** To pinch out.

**PETROGRAPHY.** The science of rocks.

**PHOSPHATE.** An ore of any metal or metals with which phosphorous and oxygen are chemically united.

**PICK.** A pick ax.

**PICUL.** A Chinese weight of 133⅓ pounds.

**PILLAR.** A section of rock or ore left in place to support shafts or roofs.

**PINCHING.** The narrowing of a vein.

**PINCHING OUT.** The narrowing of a vein to extinction.

**PIT.** An opening in the earth's surface, usually shallow.

**PITCH.** Synonymous with "dip," but occasionally used to designate the angle of decline from the horizon measured along the strike of the lode or vein.

**PITCHING.** The irregular descent of a vein.

**PLAIN.** A flat, champaign country.

**PLANT.** The machinery equipment of a mine or reduction works. In general use the term includes buildings housing machinery.

**PLAT.** The enlargement of a shaft at a level, to give extra space for loading and unloading the cage, skip or bucket.

**PLATEAU.** A flat table land, similar to a prairie, but at a higher elevation.

**PLUTONIAN.** Volcanic.

**PLUTONIC.** Rock strata of volcanic origin overlaid at some time by later beds.

**POCKET.** Underground, an ore deposit, usually of small extent. On surface, a bin at shaft house or mill, in which ore is stored.

**POCKETY.** Where a mineral body carries values very irregularly, in spots, it is said to be pockety.

**POLL-PICK.** A tool having a pick on one end, and a poll, or hammer head, on the other.

**POOD.** A Russian weight of 36.112 pounds avordupois.

**POPPET-HEAD.** Framework over a shaft for a sheave-wheel.

**POWER-DRILL.** A machine for drilling holes in rock, actuated by compressed air, steam or electricity.

**PRILL.** Cornish for selected ore secured by cobbing.

**PRIMARY.** The oldest rock formations.

**PROP.** A heavy timber placed with its foot against the floor of a mine opening and its top against the roof, to support the rock above.

**PROSPECT.** To seek for mineral: a new mining property that has not yet earned the right to be called a mine.

**PROSPECTING.** Exploratory work for mineral, on property where no regular mine has been opened.

**PROSPECTOR.** A searcher for mineral.

**PROTOXIDE.** The oxide of any metal containing the least proportion of oxygen.

**PUDDINGSTONE.** A coarse conglomerate showing rounded pebbles.

**PULLEY-STAND.** A temporary tripod or other light frame construction, holding a pulley, over which the rope used in hoisting is passed.

**PULP.** Wet, concentrated ores.

**PULVERIZE.** To crush to a powder.

**PYRRHOTITE.** Magnetic iron sulphide.

**PYRITE.** Iron disulphide.

**PYRITES.** Sulphide ores; pyrite.

**PYROGNOSTICS.** Characteristics of a mineral under the blowpipe.

**QUARRY.** An open pit, of varying size, sometimes several acres in area, from which stone or ore is mined.

**QUARTER-SECTION.** A quarter of a square mile of land; 160 acres laid out in a parallelogram, each side of which is one half mile in length.

**QUARTZ.** Silica. Dioxide of silicon, frequently containing traces of iron and other minerals, and often the gangue of gold and other metals.

**QUARTZITE.** An oxide of silicon, with other minerals in varying quantities, partly granular and partly crystalline in structure.

**QUARTZOSE.** Rock having much quartz in its composition.

**RAGGING.** Cornish for rough cobbing; middle sized broken lumps of ore.

**RAISE.** A shaft or winze that is being opened from below. Sometimes called upraise or uprise.

**RANGE.** A mineral belt, also in many American states a surveyor's term for describing and locating lands. The state is surveyed in sections (with their subdivisions), towns and ranges. A town (or township) comprises 36 sections and is a square of six miles. Each township receives a double number, one for the town and one for the range. The towns are numbered consecutively from south to north and the ranges are similarly numbered from east to west.

**RAW ORE.** Ore before treatment.

**REAMER.** A tool like a bit, used to enlarge a hole previously drilled.

**REDUCTION.** The separation of metals from their ores.

**REEF.** A stratified mineral-bearing rock formation.

**REFINING.** The elimination of impurities from crude metals, or separation of metallic alloys obtained in the reduction of ores.

**REFRACTORY.** A refractory ore is one that cannot be smelted by ordinary metallurgical processes. A refractory stamp-rock is one that is pulverized with unusual difficulty.

**REGULUS.** Copper matte.

**RESERVES.** Bodies of mineral-bearing ground opened in a mine ahead of immediate requirements.

**REVERBERATORY FURNACE.** A smelting furnace in which the flame from the grate is reflected back on the charge of ore by the roof.

**RISE.** A raise.

**ROASTING.** Driving off sulphur and other similar volatile elements from ore by heating. When done in a furnace under great heat, the process is called calcining.

**ROASTING FURNACE.** An oven for the expulsion of sulphur, arsenic and other volatile elements from ore.

**ROB.** A mine is robbed when its pillars and other supports are removed for their mineral values, regardless of the future of the property. Done only by unprincipled persons or when the mine is about to be abandoned.

**ROCK.** Stone.

**ROCK BURROW.** A pile of refuse rock from a mine.

**ROCK CAR.** An ore car.

**ROCK-CRUSHER.** A machine for reducing rock or ore to smaller sizes. Crushers are of two types, the jaw-crusher and the centrifugal. The jaw-crusher works as a man cracks nuts with his teeth, the centrifugal operates on the plan of a coffee-grinder.

**ROCK-DUMP.** The place where worthless rock is piled.

**ROCK-FILLING.** Waste rock placed in worked-out stopes as a support for the roof.

**ROCK-HOUSE.** A building where copper-bearing rock is received and put through crushers before shipment to the mill. Is really a preparatory mill. Is usually built in connection with a shaft house.

**ROLLING.** In its descent, a lode or vein, while fairly constant to a given angle on the average, frequently makes depth at irregular angles. This is called rolling.

**ROLLS.** Heavy steel rollers, worked in pairs like a clothes-wringer, used for crushing rock and ore.

**ROOF.** The rock above a mine opening.

**ROOM.** Similar to a stope; term usually applied to mines working mineral bodies lying nearly horizontally.

**ROYALTY.** A percentage paid to the fee-owner from mineral values obtained by the lessee of a mine.

**RULE-OF-THUMB.** The guess-work and rough measurement plan of mining, in contradistinction to systematic development from data obtained by careful surveying and engineering.

**RUN.** When superincumbent material is coming into mine openings, the ground is said to be running.

**SADDLE.** An anticlinal.

**SAFETY CAGE.** A cage furnished with automatic appliances to stop its descent in case the cable breaks. Usually works well in theory.

**SALT.** A chemical union of an acid with a base.

**SALTING.** Placing foreign ore in a mine to deceive intending purchasers or other interested parties.

**SAMPLE.** A specimen of ore—usually not the worst to be found in the mine.

**SAND PUMP.** A pump, usually centrifugal, designed to lift water carrying large quantities of coarse tailings.

**SANDS.** Tailings from the stamp mills of Lake Superior copper mines.

**SAND SHAFT.** A shaft sunk through sand.

**SAND WHEEL.** A large wheel, having buckets on its inner perimeter, for elevating water carrying stamp sand.

**SCALE COPPER.** Copper in very thin flakes.

**SCHIST.** A metamorphic slaty rock of foliated structure.

**SCHISTOSE.** Approximating to schist.

**SCORIA.** The slaty, porous portion of a lava flow; slags from copper smelters.

**SCRAM.** A mine that is being gone through carefully, when apparently worked out, for mineral previously overlooked; to scram.

**SCRAMMING.** Searching a mine for mineral previously overlooked.

**SCREEN.** A grating of perforated metal or woven wire.

**SEAM.** A thin layer of rock or ore.

**SECONDARY.** Rock strata of the second period.

**SECTILE.** That which may be cut easily.

**SECTION.** A field or district; also, in the United States of America, a square mile of land.

**SECTION POST.** A boundary mark set at section corners by surveyors.

**SEDIMENTARY.** Rocks formed by deposition from water, as contradistinguished from rocks formed by igneous action.

**SELVEGE.** Fluccan.

**SET.** A framed set of timber used for supporting ground in a mine.

**SHAFT.** A downward opening into a mine, with its upper end at surface.

**SHAFT-HOUSE.** A building at the mouth of a shaft, where ore or rock is landed from below.

**SHALE.** An argillaceous slate, of fissile structure.

**SHEAVE.** A grooved wheel, notched to carry rope. An open pulley.

**SHIFT.** A miner's turn, of eight to ten hours' work; a force of men employed on one turn.

**SHIFT-BOSS.** A mine boss or under captain in charge of one gang or party of miners.

**SHOE.** A stampshoe.

**SHOOT.** A chute.

**SHORT TON.** A weight of 2,000 pounds avordupois.

**SHOT.** A blast of some explosive.

**SHOT COPPER.** Small rounded nodules of native copper, somewhat resembling small shot in size and shape.

**SHUTE.** A chute.

**SILICA.** Dioxide of silicon; quartz.

**SILICATE.** An ore of any metal or metals chemically united with silica.

**SILL.** The floor-piece of a set of mine timber.

**SINKING.** The process of deepening a shaft or winze.

**SINKING-PUMP.** A pump, usually vertical, secured to a platform, and lowered as required, as the shafts are deepened.

**SKIP.** An iron box, open at the top, running on four wheels, and hauled by a cable, used in incline shafts for hoisting ore and rock and lowering timber.

**SKIP-ROAD.** A track of T-rails spiked to wooden sleepers, on which the skip runs.

**SKIP-WAY.** A skip-road.

**SLAG.** The vitreous refuse matter from a smelting-furnace.

**SLICING.** When mine pillars are removed the work is called slicing down.

**SLICKENSIDES.** A polished rock surface showing striations produced by movement of adjoining rocks under great pressure.

**SLIDE.** A dissociation of strata caused by the subsidence of the overlying rock formation.

**SLIMES.** Exceedingly small particles of rock and mineral held in solution in water, making a slimy mixture.

**SLIME TABLE.** A circular revolving table whereon slimes are worked, and the minute particles of mineral saved.

**SLIP.** A fault where a superincumbent stratum has slid downwards.

**SLUDGE.** Mixed rock and water, brought to surface where a diamond drill cuts through very soft rock: also, the tailings from a concentrator or mill.

**SLUICE.** A wooden flume or launder.

**SMELTER.** Works where ores or crude metals are freed from gangue or chemically united elements by heat.

**SMELTING.** The reduction of ores and crude metals in furnaces by heat, fuel and fluxing meterial being added to the material to be smelted.

**SMELTS.** A smelting plant.

**SOAPSTONE.** Steatite.

**SOLLAR.** A platform in a shaft.

**SPATHIC.** Having a form approximating that of feldspar.

**SPILL.** Lagging driven ahead of the regular timbering in treacherous ground.

**SPITZKASTEN.** German for a pyramidal box, wherein ores are concentrated and sized by a jet of water fed from below.

**SPOON.** A long-handled spoon used to scrape out drill holes.

**SQUARE SETS.** A form of mine timbering with mortised and tenoned sill, top piece and uprights of equal length, joined at right angles.

**SQUIB.** A fuse.

**STACK.** The chimney of a furnace; usually employed to designate a number of furnaces, when used in the plural.

**STAMP-MILL.** A mill for crushing and concentrating minerals.

**STAMP-ROCK.** Rock containing fine copper that can be secured by stamping.

**STAMPS.** Machines to crush rock or ore by heavy blows.

**STAMP-SHOE.** The heavy chilled iron casting attached to the lower end of a stamp piston that does the actual crushing of rock in a stamp mill.

**STATION.** A chamber in a shaft, cut out for pumps, etc.

**STEAM-HAMMER.** A heavy hammer actuated by steam or compressed air.

**STEAM-STAMP.** A stamp actuated by steam.

**STEATITE.** Soapstone. A greasy mineral, having a talc base.

**STEP FAULT.** A series of faults, rising like steps.

**STOCKWERK.** Country rock penetrated by numerous small stringers of ore, the entire mass averaging sufficiently rich to permit its mining and treatment.

**STOPE.** Used interchangeably to designate the excavation above a drift, or the pay rock remaining unmined above a drift.

**STOPING.** Breaking down the mass of pay rock or ore above a drift. When stoping in an ore body of average width, miners can break rock much more quickly and cheaply than when driving the drifts, which are usually about 7x7 feet in size.

**STOPING GROUND.** Ground in reserve, opened by drifts, and ready for breaking down.

**STRATA.** The successive rock layers of the earth.

**STRATIFIED.** Having regular layers of varying rock formation.

**STRATUM.** A layer or bed of rock.

**STREAK.** The color given by a mineral when scratched.

**STRIKE.** The horizontal trend of a mineral body, measured by the points of the compass.

**STRINGER.** A thin seam of ore.

**STRIPPING.** (v). Uncovering a lode, vein or bed of mineral, by removing the superincumbent earth; (n). the drift or alluvial soil overlying an ore body.

**STRUCTURE.** The form of a mineral, such as granular, crystalline or amorphous.

**STUDDLE.** A prop in a mine.

**STULL.** The top piece of a set of mine timber.

**SULPHATE.** An ore of any metal or metals with which sulphur and water are chemically united.

**SULPHIDE.** An ore of any metal or metals with which sulphur is chemically united. Sometimes called a sulphuret.

**SULPHOANTIMONIDE.** An ore of any metal or metals with which sulphur and antimony are chemically united.

**SULPHOARSENIDE.** An ore of any metal or metals with which sulphur and arsenic are chemically united.

**SULPHURET.** A sulphide. Term becoming obsolete.

**SUMP.** The bottom of a shaft, where water collects.

**SURFACE CAPTAIN.** A mine superintendent whose duties are wholly on surface.

**SURFACE RIGHTS.** The ownership of the surface of land only, where mineral rights are reserved.

**SWABSTICK.** A stick used to clean out drill-holes.

**SYNCLINAL.** A trough formed by rock strata that are low in the center and high on the sides. Reverse of an anticlinal.

**TABLE.** An ore concentrator, of which there are various forms.

**TAILINGS.** Refuse matter from a stamp mill.

**TAMPING.** Closely packing clay or other sticky earth into a drill-hole above the cartridges, to give greater force to the blast.

**TAPER OFF.** Cornish for stopping work temporarily.

**TELERA.** Spanish for a roast-heap of sulphide ore.

**TENSILE STRENGTH.** The resistance to breaking or elongation offered by metal when under strain from either end.

**TERRERO.** Spanish for waste burrows.

**TERTIARY.** Rocks of comparatively recent formation, as time is measured by geological periods.

**TEST-PIT.** A shallow pit sunk to discover mineral.

**THROW.** The vertical displacement of a vein caused by faulting.

**TIMBER.** The wooden beams and sticks used for underground supports.

**TIMBER-BOSS.** The head timberman.

**TIMBERMAN.** One who works at timbering a mine.

**TON.** See Metric, Long and Short tons.

**TONELADA.** Spanish for ton.

**TOSSING.** Jigging finely comminuted ore.

**TOWN.** See Range for description.

**TRACHYTE.** A micaceous hornblende and feldspar rock.

**TRAM.** To load rock or ore in tram-cars and push same to the shaft; a tramway.

**TRAM-CAR.** A car running underground on light T-rails, used for carrying rock from the stopes and other workings to the shafts.

**TRAMMERS.** Men who load and tram the broken rock underground.

**TRAP.** A dense gray, blue or greenish rock of volcanic origin; of considerable variety in different beds, but usually of feldspathic-augitic nature.

**TRAPPEAN.** Pertaining to trap rock.

**TREND.** The general direction of a mineral body.

**TRESTLE.** A frame-work of timbers, connecting various mine and mill buildings on surface, usually carrying tram-tracks.

**TRIBUTE.** The royalty or percentage paid by workmen to owners for the privilege of working a mine. Apt to be a form of grand larceny, at the expense of the mine's future.

**TRIBUTOR.** One who works a mine on tribute.

**TRIPOD.** The three-legged iron frame on which the working parts of a power-drill rest.

**TROLLEY-CABLE.** A wire rope sometimes used in an incline shaft as a guide for the bucket.

**TROUBLED.** A vein is troubled when disturbed or faulted.

**TSUBO.** Japanese measure of six feet square, equalling 36 square feet.

**TUFA.** (Calcareous). A porous limestone; (volcanic). Loosely cemented ash and scoria from a volcano.

**TURBINE.** The most efficient form of water-wheel.

**TUTWORK.** Development work.

**UNCONFORMABLE.** Rock strata that do not correspond as to bedding, horizons or geological age.

**UNDERHAND STOPING.** Removing ore in descending steps.

**UNDERLAY.** The mineral bodies lying under a given tract, though not outcropping on surface.

**UNPATENTED.** Mining claims held from the United States Government subject to annual assessment work.

**UNSTRATIFIED.** Rock forms not bedded in layers.

**UNWATER.** To free from water; to pump out.

**UPCAST.** A shaft having an upward air current.

**UPRAISE.** A raise.

**VAN.** To dress ore.

**VANNER.** A jig for dressing ore by means of vibratory motion, aided by jets of water to carry away gangue-rock.

**VARA.** A Spanish-American measure of 33 inches.

**VEIN.** A mineral body having defined walls. See contact vein and fissure vein.

**VEINSTUFF.** Ore with its associated gangue.

**VENTILATION.** The system of natural or artificial air currents in a mine. See air-shaft.

**VERTICAL.** Perpendicular. Upright and downright.

**VERTICAL SHAFT.** One sunk at an angle of 90° with the horizon, or directly downwards toward the center of the earth.

**VINNEY.** Cornish for copper ore with a green coating caused by weathering.

**VIRGIN.** Native metal, as distinguished from ores, which are chemical compounds.

**VITREOUS.** Of a glassy nature.

**VOLATILE.** That which can be driven off as vapor, by heat.

**VUG.** A druse. A hollow, or cave, entirely surrounded by rock. Usually shows fine crystallizations.

**WALL.** Rock of a different formation adjoining a vein or other ore body.

**WATER DRILL.** A power drill in which a current of water runs through the bit of the drill, changing the rock dust from the bit into sludge which is expelled from the bore-hole by the force of the current.

**WATER JACKETED FURNACE.** A smelting furnace provided with an outer jacket, between which and the furnace proper water is circulated.

**WATER LEVEL.** The point above which water does not rise when a mine is allowed to fill.

**WEATHERED.** Rock altered in structure by exposure to air and water.

**WET PROCESSES.** Leaching processes; lixiviation.

**WHEAL.** Cornish for mine. Synonymous with bal.

**WHIM.** A windlass with a horizontal drum.

**WHIP.** A rope and fixed pulley or pulleys, for hoisting.

**WILFLEY.** A Wilfley concentrating table.

**WINCH.** A windlass.

**WINDLASS.** A winding device for hoisting from a pit or shaft, by means of coiling a rope or cable around a drum.

**WIRE BARS.** Refined copper cast into bars for wire drawing.

**WORKINGS.** The underground openings of a mine.

**YELLOW COPPER ORE.** Chalcopyrite.

**ZINC BLENDE.** Sphalerite. Sulphide of zinc.

# CHAPTER VII.

## COPPER DEPOSITS OF THE UNITED STATES.

In this chapter will be found synopses of the principal features of interest, scientifically and commercially, of the copper deposits of the United States, arranged by states and territories, in alphabetical order.

**ALABAMA.** This state possesses deposits of chalcopyrite ore occurring as veins in igneous rocks, in Cleburne and Randolph counties. The upper portions of at least two of these veins carried good values in oxide and carbonate ores, with some associated gold and silver values, and occasional sheets of native copper. Two mines were worked quite extensively in the seventies. These were closed when the altered ores were replaced at depth by sulphides. There has recently been some revival of interest in Alabama copper ores, which, so far as known, are confined to the northwestern corner of the state, and some development work is now under way.

**ALASKA.** In giving consideration to the mineral deposits of Alaska, it must be borne in mind that this territory is an empire in itself, having a greater area than France and Germany combined. The copper deposits, known and partially prospected, are scattered over a vast territory, and occur under such varying geological and geographical conditions that comments pertinent to one district might be entirely inapplicable to another. Alaskan copper deposits cannot be considered as one district, but as a number of separate fields, with all the distinctions implied thereby.

It may be said, in a general way, that there is much copper in Alaska. It may also be said that there are many and able liars in Alaska. There is little question that the various placer gold camps of interior Alaska and the Yukon have been systematically boomed by an organized claque, to the benefit of sundry transportation lines and outfitting firms. Many of the press despatches have been of a misleading nature, and there are evidences that similar systematic promotion of a copper mining boom is being attempted. This is not intended to apply to the local newspapers of Alaska, but to certain not always veracious correspondents, and to various newspapers along the Pacific coast. This criticism will doubtless bring forth warm expostulations, and perhaps the author will be accused of attempting to deliberately injure a new and promising copper field, though such is not the case. There is every likelihood that good copper mines will be opened in Alaska. In fact, several now opening are of more than ordinary promise, but there has been so much of exaggeration, of misrepresentation and of downright lying, about Alaskan copper deposits, that the reported finds of mountains of pure copper must be taken *cum grano salis*. The bogus mine promoter always finds his most profitable field in a district far from centers of population and difficult of access. Ten years ago Arizona was filled with wildcat mines and mining fakers of all grades, and they gave that territory a very bad reputation among investors. This bad state of affairs has been greatly ameliorated of late, and while there are still salted mines and mine salters in Arizona, the standard of mining and mine promotion has been greatly raised in the past few years, as the district has become more accessible and better known. Alaska is today where Arizona was ten years ago—a *terra incognita*, where all things are possible, and a country of such magnificent distances that the natural-born liar finds opportunities of outdoing his own best records. There are fine copper mines awaiting opening in Alaska, but there are also cleverly made bogus gold bricks awaiting purchasers. The country undoubtedly offers great opportunities to investors with the capital, skill and business sense required for successful mining in any part of the world, but common business prudence dictates careful examination by competent experts before the investment of money. All legitimate mining districts court this sort of investigation.

Copper is reported as occurring at many points in Alaska, prominent among which are the valleys of the Copper, White, Chitna and Tanana rivers; on Latouche and Prince of Wales islands, along the Mt. St. Elias range; at various inland points in the Ketchikan district; on the Scolai range; at Sunrise, and elsewhere. Alaska is a hilly and often mountainous country, except along the tundra of the Arctic circle, and the valleys of the large rivers, often five to thirty miles in width, are the natural highways for prospectors, hence it arises that mineral discoveries are first reported from them, in the interior districts.

The copper fields of the Copper river and its principal tributaries have attracted the widest attention, though the most important developments are along the coast. The Copper river basin, with the valleys of its tributary rivers, is a vast field, and will require many years for even a fairly complete preliminary examination. This basin is a broad synclinorium, the central part of which is occupied by the Wrangell Mountains, which are of Tertiary age. Copper ores are reported from many points along the valley of the Chitna and between that river and Mt. Wrangell.

The White river is a tributary of the Yukon, with a generally northerly trend. Kletsan creek, a small tributary of the upper White, has excited much interest, because of the occurrence of native copper, which has been gathered and used by the natives for arrow-heads, bullets and ornaments. Scolai Pass is the divide between the head waters of the White and Chitna rivers. Mr. James Lindsay, a well-known consulting engineer of Portland, Ore., spent the spring and summer of 1902 in Alaska, and made a very careful examination of the upper White river copper fields. He informs me that the much-talked-of Kletsan creek is apparently of little importance as a possible future source of copper supply. The native copper occurs in placer form only, and has evidently been derived from ancient basaltic dikes intersecting greenstone diorite and carboniferous limestone. The river valley for a hundred miles east from Scolai Pass is covered with volcanic ash, which is over 100 feet deep at the international boundary line on the White river. This volcanic ash meets the perpetual snow and ice at an altitude of 6,000 feet on the mountains, and the cupriferous veins are most effectually hidden by the scoria or by the everlasting ice and snow, affording about as discouraging a prospect for exploration as could be found at any point on the globe. The United States Geological Survey reports that the largest placer nuggets of copper in the Kletsan creek valley weigh eight to ten pounds, and that investigation disclosed the original home of the placer copper to be in the greenstones, which were traversed by irregular joints, in which calcite was deposited, and these were found to carry copper, the veins so found being small and of no commercial value. All of the cupriferous veins were in contact with the limestone. In the same neighborhood are trappean amygdaloids carrying amygdules of chalcopyrite.

Discoveries of native copper, bornite and chalcopyrite are reported from the Kotsina river. Near the Kuskulana river a mass of native copper, three feet wide and eight feet long, was found.

On the islands and mainland in the Prince William's Sound district a number of promising properties have been opened, one of the most advanced being on Latouche Island. The Alaska Central railroad is to run from Valdez, at the head of Resurrection Bay, on Prince William's Sound, to Rampart, on the Yukon river, near the Arctic circle and international boundary line. Preliminary surveys have been made and while the exact route of the line is not fully determined at all points, the road will run along the valley of the Copper river from Copper Center to Mentasta Pass, thence northwesterly, crossing the upper Tanana to the Yukon, a distance of approximately 400 miles. This railroad will traverse several promising mineral districts, and its construction seems assured.

At the present time the most important copper district of Alaska is in the vicinity of Ketchikan, in southern Alaska. On Prince of Wales Island several mines are being opened on veins of sulphide ore that are apparently of good width and permanence, and which carry gold and silver as well as fair percentages of copper. This district has the advantage of tide-water, giving cheap and fairly rapid communication with the cities of Puget Sound and the Pacific coast of the United States. It is quite certain that the first regularly producing copper mines of Alaska will be developed here, and some of them should become factors in the world's production during the present year.

**ARIZONA.** Arizona is the third district of the United States and the fourth in the world in point of productive capacity. No other copper field has shown such marked gains in production during the past decade, and there is every reason to believe that the output will continue to increase for many years to come.

Arizona has nearly a quarter of the copper mines of the United States. Many of them are of very doubtful value; a few are of fully demonstrated worth, and a considerable number give promise of becoming both large and profitable producers. The mere fact that a copper mine is located in Arizona should not prejudice opinion for or against it. Some of the best and some of the worst mines ever opened are in this territory, and each mine should be judged individually, upon its merits.

There are evidences of rude mining by prehistoric peoples at a number of points in the territory, but no traces of smelting, and had the copper ores been reduced, the slags, and possibly remnants of the furnaces, could hardly have escaped attention in modern days. It seems likely that the iron ochres, malachite and azurite were mined in a crude way, for pigments. Prehistoric turquoise mines have been found at several points, notably in the Dragoon Mountain range.

The first copper made in Arizona was turned out of an adobe furnace at the Longfellow mine, Clifton, in 1873. The nearest railroad point was 800 miles distant at that time. The development of the mineral resources of the territory of Arizona has been a remarkable one, during the three decades that have since elapsed.

The copper zone of Arizona, broadly speaking, has a general southeasterly and northwesterly trend, and the copper deposits, as a rule, are found along the contacts of igneous rocks, such as porphyry and diorite, with limestone of the Paleozoic group, mostly of the carboniferous series. The general geological conditions of Arizona are much the same as in the adjoining Mexican state of Sonora.

Copper ores are found in more or less profusion in every county of the territory. The counties are of princely size, and as the topography ranges from hilly to mountainous in most parts, not even the best known districts have been developed yet, or even fully prospected. Nearly all of the ores of copper are found in Arizona, and native copper is of not uncommon occurrence, especially in the mines at Clifton and Bisbee. The principal copper districts are four in number, as follows: Bisbee, in Cochise county, only six miles from the Mexican border; Jerome, Yavapai county, in the northwestern part of the state; Clifton, including Morenci, in Graham county, north of Bisbee and close to the New Mexican border; Globe, Pinal county, not far from the center of the territory. In addition to these four principal districts, all of which are considerable producers, in about the order given, there are a dozen or more smaller districts, such as the Helvetia, in Pima county; the Wickenburg, and others.

The Bisbee district, of which the town of that name is the center, is really a part, geographically, of the great Sonoran copper belt of Mexico. The ore deposits occur in carboniferous limestones, bedded in nearly horizontal planes, and underlaid by quartzite. The veins are notable for the quantity of fluccan along the walls, and are easily mined as a rule. The clay carries considerable finely comminuted native copper and masses of native metal of respectable size are occasionally encountered. The oxidized zone extends to a depth of perhaps 400 feet and is succeeded by unaltered iron-copper sulphides that average excellent values. The oxidized zone is notable for the richness and extent of its high-grade carbonate ores.

The country rock of the Jerome district is slate, extensively intruded by dioritic igneous rocks, slates and diorites having a capping of uncomformable limestones of later age and devoid of copper. There is a limited zone of oxidized ores, but the principal dependence is placed upon the unaltered disseminated sulphides. These are by no means remarkable for their high percentages of copper, but are notable for their great extent and the high values carried in gold and silver.

The Clifton district has quartzite and limestones superimposed on granite, with intrusive igneous rocks of both basic and acid types, the entire formation being greatly faulted. Ore occurs in both the eruptive rocks and the limestones. It was in this district that the first Arizona copper mining was done, three decades ago. There were very extensive deposits of rich oxidized ores near the surface, along the contacts between the porphyry and magnesian limestone. These ores were self-fluxing and highly profitable but gave out at shallow depth, and, contrary to the usual rule, were not succeeded by sulphides. Extensive openings, on the porphyry of Humboldt Mountain, have developed enormous beds of low-grade sulphides, during the past ten years, and these are now the mainstay of the district, though some carbonate ores are still mined. The leaching process, little used in the United States, is employed to advantage in the treatment of certain of the low-grade ores of this district.

The first mining in the Globe district was done in 1876, and was for silver. The Old Dominion, the principal producer and a typical mine of this field, is opened on a contact vein between a diorite foot and a hanging of carboniferous limestone, over the greater part of which there is a trachyte capping. The principal ore bodies are in the limestone, and the ores are mostly oxidized. A peculiar feature is the presence of a sulphide zone which has oxidized ores both above and below. The ores are highly silicious and require heavy fluxing with iron and lime. The lack of sulphide ores, to furnish the iron needed in fluxing, is one of the most serious drawbacks of this district. It seems likely that ample bodies of unaltered sulphides will be found at some future time, in or adjacent to this district, where operations are further handicapped by very high freight rates on coke and other supplies.

Political expediency should not be allowed to longer prevent the admission of the territory of Arizona into the sisterhood of states. The territory has the population, resources and assured future that are necessary requisites of statehood, and should no longer be kept in leading strings, when both able and willing to conduct its own affairs as an independent commonwealth.

**ARKANSAS.** Tetrahedrite and tennantite occur in the Kellogg mine, Pulaski county, only ten miles north of Little Rock, the capital of the state. These are not commonly considered as commercial ores of copper, owing to their refractory nature and the highly deleterious effects of both antimony and bismuth upon finished copper, even in small amounts. Antimonial and bismuthiferous ores are rarely worked, unless carrying considerable values in silver, as is the case at Butte, in Algeria, and at other points.

**CALIFORNIA.** There are few states in the American union more richly endowed with copper than California. To give the names of all the counties in which copper is mined or found would be nearly equivalent to calling the roster of the state, as there are but few in which ores of the metal are not found in more or less profusion.

It may be said, in a general way, that there are two copper belts in the state, one following the Coast Range mountains, while the other is found in the foothills of the Sierras. Both belts have a north and south trend, and extend through practically the entire state. The Sierran belt reaches from Oregon on the north, through the counties of Lassen, Plumas, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras, Tuolumne, Mariposa, Madera, Fresno, Tulare, Kern, Los Angeles, San Bernardino, and Riverside, to the Lower California line. The Coast Range belt extends from Del Norte to San Diego, across the state from north to south. In Kern county there is an apparent branching of the Sierran copper range, with an offshoot that traverses Inyo and San Bernardino counties, then enters the neighboring territory of Arizona, thus establishing a close geological and geographical connection between the copper measures of Arizona and California.

The Californian copper beds are found in close proximity to the gold-fields, and much of the copper ore carries considerable values in gold. In the northern part of the state the gold and copper veins are apparently interwoven. There are ample evidences of intense volcanic action in this section, and in Shasta and adjoining counties the copper deposits are almost invariably auriferous to a profitable extent.

The first Californian copper mining was done in 1860, at Copperopolis. Considerable ore was shipped to New York, Baltimore and Swansea for reduction, and in 1863–1866 no less than nine small smelters were built in the state, copper production reaching nearly 2,000,000 pounds in 1864. The great fall in price brought operations to a stop in 1867–68, and almost no copper mining was done after that time until 1895, when an English company bought the "worthless" Iron Mountain mine in Shasta county, and in seven years has made it one of the world's great copper producers.

Although there are several other districts of promise, Shasta county is the source of the principal production, and the scene of the greatest activity in the development of new mines. This belt is from half a mile to four miles wide, with an average width of perhaps less than two miles, and a proven length of about twenty miles, though possibly much longer. The belt has a crescent form, with the principal developments at the western end. The country rock is porphyry, with slate to the west and granite and quartzite to the east. The beds occur as mammoth, flat-lying lenses of low-grade auriferous sulphide ores of copper, usually capped by massive beds of gossan. One considerable body of silicious ore has been opened by the Mt. Shasta Gold Mines Corporation.

As a rule the alteration zone of Californian copper deposits is comparatively shallow. While the high-grade oxidized ores are found in large quantities at surface and for a little depth, the unaltered iron-sulphides usually come in at a depth of about one hundred feet, hence the big mines of the state will be, like the Mountain, low-grade mines operated on a very large scale.

Next to Shasta the copper producing counties of California rank in about the following order of importance: Calaveras, Fresno, San Berdardino, Kern, Mariposa, Madera, Merced, Stanislaus, Amador.

Native copper has been found at Napoleon, Calaveras county; at Cosumnes, Amador county, and elsewhere.

**COLORADO.** With the exception of an extensive plateau in the eastern part of the state, Colorado is heavily mineralized at nearly all points, and while gold and silver have been most extensively exploited, copper, iron and the other minerals exist in abundance in many parts. Copper ores are found in the counties of Boulder, Chaffee, Clear Creek, Custer, Gilpin, Gunnison, Hinsdale, Huerfano, Lake, La Plata, Ouray, Park, Pitkin, Rio Grande, San Juan, San Miguel, and Summit.

The production of refined copper by Colorado mines has run up into the thousands of tons for some years past, but almost without exception this has been secured as a by-product from the smelting of gold, silver and lead ores. The sulphide ores predominate and are found at many points. At present a number of copper mines are being opened, mainly in San Juan county near the New Mexico border, and in the northern part of the state near the Wyoming line.

**CONNECTICUT.** There are two copper mines in Connecticut, from which ore has been produced occasionally during the past century, these being the Newgate at Granby, and the Bristol in the town of that name, but both are idle at present. Malachite, bornite, chalcocite and chalcopyrite are found at Bristol; cuprite, malachite, chalcocite and bornite are found at Cheshire; chalcopyrite occurs at Middletown, New Britain, Roxbury, Bolton, Brookfield, Sunsbury, Litchfield and other points, and native copper is found at Farmington in red sandstone. A 200-pound mass of native copper was found in alluvium near New Haven. Copper ore was also found near Montville in 1902.

**DELAWARE.** Chalcopyrite has been found in the quarries of the Wilmington Granite Co., on the Brandywine river, near Wilmington, but no workable deposits of copper ore are known to exist in this state.

**FLORIDA.** No important or workable bodies of copper ore are known to exist in this state, but small veins of sulphide ores have been found at several different points.

**GEORGIA.** Copper ores exist in the counties of Fannin, Lincoln and Rabun, and probably in other parts of Georgia. Considerable chalcopyrite is found in Fannin county, at a point only two miles distant from the copper mines of Ducktown, Tennessee. At present there is but one active producer of copper in the state, this being the old Magruder mine, now owned by the Seminole Copper Co., but reopening work is being done at the Canton mine, and a small amount of work is under way at other points.

**IDAHO.** Although Idaho has never been a large producer of copper, the state possesses important deposits of ore at several points, and a large amount of development work is now under way. Copper ore is found in the counties of Alturas, Brigham, Custer, Idaho, Lemhi, Shoshone and Washington, and possibly elsewhere, as the entire state is richly endowed with metals, and the exploration and development of its mineral wealth has been by no means commensurate with the opportunities. The principal copper developments of the present are in Custer, Washington and Lemhi counties. The ores are mainly carbonates and sulphides, though other forms occur and native copper has been found in the sluice-boxes of the gold mines at Murray.

There was much interest aroused in the Seven Devils district a few years ago, but for some reason that does not seem quite clear, this district with the diabolical name has failed to develop any regular copper producers, though ore of the best grade has been found. Sooner or later there should be some good mines opened in this district.

The principal copper mining operations of the present are carried on in Custer county, by the White Knob company. A vast amount of work has been done at this point, and while the ore is of low grade it is hoped that the mining may prove profitable, by reason of operating on a great scale.

The Coeur d'Alene copper district is receiving some attention at present, and has a number of promising prospects. Although silver-lead mines have been operated for years in this district, it was not until 1898 that any attempt was made at copper mining. At present there is a considerable activity in this field, though none of the copper mines have passed beyond the stage of prospects.

**ILLINOIS.** Native copper, occurring as drift, in the alluvium, is of rather common occurrence in Illinois, but is, of course, of no commercial importance. The only deposits of copper ore in place known in the state are in Hardin and Chittenden counties. Chalcopyrite has been found in fair quantities near Rosiclare, Hardin county, and during 1902 considerable copper was found, in connection with lead and spar, in Hardin and Chittenden counties, and an attempt was made at organizing a company to open a mine.

**KANSAS.** The rock strata of Kansas range from carboniferous to tertiary, but the igneous rocks are lacking, and without them there seems slight likelihood of discovering important copper deposits. A little chalcopyrite in tetrahedral crystals has been taken from the lead and zinc mines of Galena, Cherokee county, in the southwestern corner of the state.

**KENTUCKY.** A little chalcopyrite has been found in Livingston and Union counties, but the deposits do not promise to be of any special value industrially.

**LOUISIANA.** No copper deposits of industrial importance are known in this state, but there is an interesting occurrence of chalcopyrite in a peak deposit of galena, sphalerite and baryte in halite (rock-salt) on Belle Isle, near the mouth of the Atchafalaya river.

**MAINE.** Some of the earliest copper mining in America was done in the Pine Tree state, and a smelter was built at Taineston previous to 1840. Chalcopyrite is found in the lead mines at Lubec, also near Dexter, and in Sullivan, Franklin, Hancock, Topsham, Parsonfield, Whiting and elsewhere. Chalcopyrite, chalcocite, bornite, cuprite and tetrahedite occur at Blue Hill. There are old copper mines near Calais, on the New Brunswick border, and about 1880 there was a local copper boom that led to the opening of mines at Blue Hill and Sullivan, in Hancock county, but these did not prove profitable or long-lived.

**MARYLAND.** Copper mines were worked in this state in colonial days and during the first half of the nineteenth century. There are three cupriferous measures of some little extent, and the copper mines of Maryland were actually of some importance as producers, until the discovery and exploitation of the rich native metal mines of Lake Superior put a quietus on copper mining along the Atlantic seaboard.

The Maryland ores are mainly chalcopyrite and bornite, with occasional malachite. Of the three principal districts of the state, the most important is in Frederick county, running along the Linganore hills, from New London northward to a point beyond Libertytown, the ore occurring in slates and limestones. The second district, in Carroll county, is found mainly between Sykesville and Finksburg, with the ore in slates. The third district is in Baltimore county, at Bare Hills, where sulphide ores are found in hornblende gneiss.

**MASSACHUSETTS.** There is more or less copper at various points in the Old Bay State, and fitful attempts have been made at opening mines, but none have resulted from the short-lived operations. A little native copper is found in some of the triassic sandstone strata, and chalcopyrite is found in the lead mines at Southampton, also near Deerfield, at Turners Falls, Hatfield, Sterling, Rowe, Leverett, New Marlborough and Russell, also chalcopyrite and tetrahedrite at Newburyport. Prof. W. O. Crosby, of the Massachusetts Institute of Technology, furnishes me with particulars regarding the new copper prospect opened in western Massachusetts in 1902, a description of which will be found under the name of the New England Mining Co.

**MICHIGAN.** While the Keweenawan formation of Lake Superior outcrops in Wisconsin and Minnesota to the west, and upon the Canadian shore of Lake Superior as well, the developed and productive mines ot the district lie wholly within the limits of the state of Michigan, Copper ores are found in the granite lying north of the iron belt in Marquette county, and one mine is being developed thereon, but for all practical purposes the copper belt of Michigan is contained in the three counties of Keweenaw, Houghton and Ontonagon, stretching from east to west, from the point of the Keweenaw peninsula along the mainland of the western half of the southern shore of Lake Superior. There are also abandoned copper mines on Isle Royale, which is now practically uninhabited except in summer. The Keweenawan formation stretches through Gogebic county, and across the Wisconsin line into Minnesota, but there never have been any producing mines west of Ontonagon county.

The formation carrying the cupriferous lodes and veins of the Lake Superior district is composed of old lava flows, supplemented by beds of conglomerate formed by the deposition of rocks, broken from adjacent shores, upon old sea-beds. This belt of Keweenawan rocks, so called from its predominance in the Keweenaw Peninsula, where first noted by early geologists, is of considerable extent. It forms a trough, or synclinal, the southern edge outcropping on the Keweenaw Peninsula and to the westward along the southern shore of the lake, and it is with this southern edge that we have to do. The other outcrop of the rock strata forming this trough is noted on Isle Royale, and on the northern shore of the greater part of the western half of Lake Superior; also on the southern shore of the lake in Douglas county, Wisconsin, and again on Michipicoten island and the adjoining northern shore, at nearly the extreme eastern end of Lake Superior. The axial line of the synclinal seems to run somewhat north of east, but there is marked diversity in the trend of the southern outcrop where mining is actively prosecuted, the strike ranging from nearly due East and West to North 30° East in the Portage Lake district. Broadly speaking, Lake Superior rests in the trough of the Keweenawan series.

Discarding further consideration of the northern outcrop of the series, where the dip is to the southward, it may be said that the dip of all of the southern outcrop of the Keeweenawan beds is to the northward or northwestward. The cupriferous strata on the Keweenaw peninsula have sandstone to either side. The underlying sandstone, to the east and south, is generally held to be unconformable with the traps of the Keweenawan group, and has been identified by Dr. L. L. Hubbard as of the Potsdam series. Copper is occasionally found in the eastern sandstone, near the point of contact with the trap, where evidences of igneous influence are quite plainly discernible; and in Ontonagon county fine copper has been found in the overlying sandstone conglomerate of the Porcupine mountains. The western sandstone is superimposed upon the Keweenawan beds and is apparently in place.

The outcrop of the Keweenawan formation, between the two sandstones, is from two to six miles wide, roughly speaking, and is narrowest where the dip of the strata is greatest, and widest where the strata dip least sharply. Toward the middle of the Keweenaw peninsula the western sandstone is lost under the lake, and at Bete Gris bay the eastern sandstone also plunges beneath

Lake Superior, leaving the traps and conglomerates in sole possession of the tip of the peninsula for the last ten miles, the waters covering the entire formation at the end of Keweenaw Point.

The Keweenawan series consists of three elementarily distinct classes of rock, though the subdivisions are numerous. These principal groups are the traps, amygdaloids and conglomerates. The two former are old lava flows, while conglomerates are composed of broken rock, sand and gravel, cemented by pressure, and were once seabeds. The traps and amygdaloids are in many respects similar, the main difference being in the greater density and uniformity of the traps. The copper is found in a chemically pure, or native state, in the amygdaloids and conglomerates, and occasionally, to a limited extent, in the traps. The theory most commonly held is that the copper was dedeposited by precipitation in the cavities in the strata from the waters of a sea above. The traps being dense rocks, usually basic, there was little chance for the deposition of copper therein. The amygdaloids contained an infinite variety of granular and crystalline rock forms, the calcareous and silicious portions of which were dissolved quite readily by the waters, presumably powerfully impregnated with salts, and in the apertures left by the dissolution of the chalky and sandy nodules, the copper was deposited when precipitated from the waters above. There is also a theory that the copper is purely of igneous origin.

A cross-section of the formation at any given point would show a large number of trap, amygdaloid and conglomerate strata, lying one upon the other, from south to north. These vary greatly in thickness, but are persistent both as to length and depth. There must necessarily be an end to even the greatest lava-flow, and owing to inequalities existing on the land-surface or sea-bed over which these old flows spread, the stratum may be temporarily cut out, to reappear at greater depth, or to the sides of the point of disappearance.

Geological observation in the Lake district has been founded very largely on the conglomerates as base-lines, and many conglomerate reefs have been identified and traced for considerable distances. This system of geological identification is obviously correct, as the conglomerates differ more radically from the traps and amygdaloids than do the latter from each other. All of the various strata of traps, amygdaloids and conglomerates vary from each other to a greater or less extent, according to their chemical and petrographical formation, crystallization, and alterative influences to which they were subjected after their original deposition. Some of the traps are blue, others greenish in color, with various minerals added to the original diabase, such as augite, prehnite, calcite, and others. In addition to the diabase, there are felsite and porphyritic rocks, richer in silica.

Of the conglomerates, many carry copper in minute quantities, but only two have been mined, these being the Calumet and Allouez conglomerate reefs. Nearly all the amygdaloids carry copper to some extent, but not all have it in sufficient quantity to render mining profitable. With the exception of three mines working on conglomerates and two on veins, all the active mines of the district, including producers and properties in process of development, are opened on amygdaloid lodes.

In addition to the main portion of the Keweenawan series, which consists principally of eruptive rocks, a second division, mainly of sedimentary rocks, was formed at a later period, and in this second division the Nonesuch mine, in the Porcupine Mountains, was opened and found very rich in fine copper. The second division of the Keweenawan series was formed mainly by the breaking down of the eruptive rocks of the preceding formation, and the redeposition of the detrital rock so secured in the form of conglomerates and sandstones.

The crystalline rocks stand higher than the adjacent strata that had less power of resisting the elements and glacial action. These latter have been much eroded in ages past, in consequence of which the copper-bearing belt forms a ridge rising from 400 to 800 feet above the level of Lake Superior, with the sandstone sloping to the water from either side. In many places, especially at the crests and escarpments of the igneous strata, the naked rock stands out strongly, but the lower portions are covered with drift. In places an overburden of 200 or more feet of sand is found surmounting the rock, and swamps above the ledge of solid rock are of frequent occurrence. These are serious obstacles to the locating of mineral deposits, and also hinder the geological exploration of the district.

The dip of the various strata, copper-bearing and otherwise, varies greatly at different points, ranging from 73° with the horizon at the Baltic, to as flat as 25° at the Arnold. In a general way the dip of the trap series is sharpest when the trap belt, as exposed at surface, is narrowest; and flattest where the trap formation is widest. In a general way it may also be said that the dip of the strata is sharpest nearest the eastern sandstone and flattest nearest the western sandstone, an evidence of a folding or pushing force exerted from the direction of the eastern or Potsdam sandstone. The contact of the eastern sandstone is much tilted from the apparently horizontal position occupied a little further east, the sandstone standing almost vertically at some places where adjoining the eruptive rocks.

In addition to the copper-bearing amygdaloids and conglomerates, there are other sources of copper supply of minor value. The first of these in importance, judging from the amount of copper produced in the past, is found in the fissure veins. These cross the formation at approximately right angles and as a rule are nearly vertical in dip. The copper in these was presumably deposited in the same manner as the crevices in the amygdaloids and traps were filled with the same metal. The second source of copper is in the contact veins, of which the old Minnesota mine affords much the best example. The third source of copper is found in the ores. The Cliff, the first and one of the greatest dividend-payers among Michigan copper mines, was opened originally as a mine of black oxide of copper. The Calumet & Hecla was noted, when first opened in 1866, for the large amount of malachite found in the conglomerate near surface but in this instance the carbonate had been formed by the action of the elements from the native copper, which replaced it at a little depth. Various fissure veins of copper ore have been found, especially on Keweenaw Point, well toward the eastern end.

The existence of native copper on the southern shore of Lake Superior was first made known to the world by the intrepid Jesuit missionaries of France, who visited the unknown inland sea early in the Seventeenth century. Native copper was found by other explorers in that and the succeeding century, and in 1770 one Captain Jonathan Carver printed a book in London, telling, among other things, of the richness of Lake Superior in copper, which had but to be picked up and carried away. This led to the formation of a copper mining company in London, and a party of miners sent over from England worked on the banks of the Ontonagon river in the winter of 1771–72, under the direction of Alexander Henry, an adventurous Englishman who had turned hunter, trapper and finally miner. A long adit was driven in a clay bank; this caved in when the rains came in the spring, and no further attempts were made at mining copper for seventy years.

In 1830 the southern shore of Lake Superior was first visited by Dr. Douglass Houghton, of Detroit, a young scientist combining with his technical skill rare and valuable courage and practical knowledge of men and matters. Through his indefatigable efforts the upper peninsula of Michigan was first surveyed, and the discoveries of Dr. Houghton led to the exploitation of both the copper and iron measures of the Lake Superior district, now among the most valuable and productive mineral fields of the world. The first "miners" to reach the Lake Superior copper fields were Jim Paull and Nick Miniclear, two backwoodsmen who came overland from southern Wisconsin in midwinter, suffering great hardships, and arrived on the shore of the great lake in March, 1843. The federal government opened a land office at Copper Harbor in the same year, and a number of hardy prospectors begun work before navigation was closed by the storms of early fall. More miners, most of whom were devoid of practical knowledge, arrived in the following year, and as the news of important discoveries became bruited about, the first Cornish miners arrived to do real mining. The operations of the first two or three years were productive of little but knowledge, secured by mistakes that now appear ridiculous. The first copper in any quantity of importance was taken from a vein of melaconite in Keweenaw county in 1846; the same company opened a fissure vein of native copper a little later, and begun the payment of dividends in 1849, since which time there have been dividends paid in each successive year by Lake Superior copper mines. But little later than the early operations of the Cliff company in Keweenaw county were the pioneer operations of the Minnesota company, in Ontonagon county, at the other end of the district. Extensive remains of prehistoric mines were found at many points, and a number of the best mines of the district have been developed on lodes revealed by lines of old pits.

In the earlier years of development the profitable mines were opened on fissure veins in Keweenaw county, and on the contact veins of Ontonagon county. The middle, or Portage Lake district, was held to be of little promise, and the attempts made to open paying mines on the stratified beds were regarded with amused contempt by the successful operators of vein mines, until at last the Quincy mine made a success of an amygdaloid lode. At present all but two of the active mines of the Lake district are opened on stratified beds, and of the two remaining mines, one is equipping a mill to treat copper from fissure veins in Keweenaw county, and the other is reopening the old contact vein of the Minnesota mine in Ontonagon county, in addition to developing a new mine on an amygdaloid bed.

**MINNESOTA.** The western continuation of the Keweenawan cupriferous formation extends from the upper peninsula of Michigan across northern Wisconsin into Minnesota. The Keweenawan rocks are found in Cook, St. Louis and Pine counties in the northeastern part of the state and short-lived attempts at prospecting have been done in all three counties. Native copper and malachite have been found in Chisago county. An occurrence of copper of geological interest, though of no commercial importance, was noted in St. Louis county in 1900, when the Montana shaft of the Minnesota Iron Company yielded about 100 pounds of native copper, found in sheet form imbedded in iron ore, at a depth of about 300 feet.

**MISSOURI.** Carbonate and sulphide ores occur at a variety of points in this state, and a number of small mines have been opened, though none are now working. Native copper and various ores are found in the Stanton mine in Franklin county. Malachite, azurite and chalcopyrite occur in the Circle Diggings of Cole county, and at the Collins mine in Cooper county. Malachite has been found in the Cherry Valley mines of Crawford county. A little chalcopyrite is found at times with the sphalerite in the zinc mines of the Joplin district, in Jasper county. The O'Bannon and Buckeye mines at Fredericktown, Madison county, were once worked for copper, and while in the Catherine lead mines, near Fredericktown, in October, 1902, I secured a little chalcopyrite from magnesian limestone carrying disseminated galena. Chalcopyrite has been found in Jefferson county, and Shannon county had a short-lived copper boom in 1901.

The Cornwall and Swansea copper mines were opened in 1863 on parallel blanket veins of disseminated chalcopyrite with chert gangue in a country rock of silurian limestone. The southern half of the state, from the Mississippi river to the Kansas line, possesses great mineral wealth, and while the principal developments will probably be in lead, zinc and iron, the opening of a profitable copper mine is by no means impossible, as the southern Missouri formation of magnesian limestone of carboniferous age, intruded by granite and porphyry, is one that has given to the world some of its best copper mines in other fields.

**MONTANA.** The Butte camp of Silver Bow county is now, and for several years has been the largest producer of copper of any district in the world. Copper ore is found in the counties of Beaverhead, Cascade, Deer Lodge, Granite, Jefferson, Madison, Meagher, Lewis & Clarke, Park, Silver Bow and Teton. A little mining is done outside of Silver Bow county, and in these districts the ores are mainly sulphides, usually in association with diorites appearing as intrusives in a quartzite country rock of Cambrian age.

The Butte camp is approximately a rectangle of four by seven miles, but the more important mines and principal production are in an area of little more than two square miles. From this little spot has come hundreds of millions of dollars worth of copper, silver and gold, and under normal circumstances the production of this district, small only in area, is not less than 10,000 tons of refined copper monthly—an amount fifty per cent greater than the output of any other cupriferous district of the world.

Butte was originally a placer gold camp, but as such was of small importance and short life. Silver mines were opened later, and these turned into copper mines at depth. As early as 1880 the Parrot and Boston & Colorado mines were making argentiferous matte, and in the following year was begun the great development that transformed Butte into the world's greatest copper camp within a decade.

The country rock of the Butte district is granite, of which the Butte granite is the elder and the Bluebird an intrusive. The ore bodies are of very irregular form, occurring in veins ranging from mere seams up to 100 feet in width, with many bulgings and pinchings from point to point, but with a general tendency toward greater width at depth. The veins are considerably faulted and cut by horses of dykerock. The walls are poorly defined in many cases, and this gives rise to the plausible theory that the veins have been formed along a series of small fissures marking a line of disturbance, rather than from a general faulting, and that these small fissures have been greatly enlarged at many points by replacement of the original walls. The veins are nearly all mineralized and form a veritable network underground, crossing, interweaving, pinching, enlarging and behaving generally in the most erratic manner. The damnable mining laws of the United States are peculiarly adapted to the fomentation of mining litigation, and as a consequence of the physical and scientific impossibility of determining the apices of many of the veins, the principal mining interests of this district have become entangled in a maze of lawsuits that cannot be settled during the lifetime of the present generation, unless the litigants can arrive at some understanding out of court, or the weaker parties be driven to the wall. That the mines work and earn good profits after paying the millions spent in litigation is strong evidence of the richness of the district. In a camp like Butte, every mining claim should carry its title to the side-walls, and not an inch beyond. Any other system, and most especially such a cumbersome and dishonest system as furnished by the present federal mining laws, is an incentive to rascality, a discouragement to legitimate mining, and a disgrace to the country responsible for laws so utterly at variance with common sense and common honesty.

The gangue of most of the ore bodies is granitic or silicious. A little native copper is found in the granite at points. In the case of most mines of the district the upper levels carry high values in silver with only a trivial amount of copper, the latter averaging one per cent. or less. This oxidized zone has a depth of 200 to 400 feet as a rule. Below this there is a median zone, frequently characterized by veins almost or quite barren of either copper or silver values in the upper section, followed by the richer sulphides. This middle zone varies greatly in characteristics in different shafts. The third or lowest zone is found at about the water level, where the ore becomes unaltered iron sulphides. Unfortunately for the peace of mind of geologists and mineralogists, the Never Sweat mine is now producing the extremely rich ore chalcocite from its 2,200 foot level. This occurrence does not fit in with any of the generally accepted theories of copper deposition, which is bad for the theories. Below the permanent water level the ore bodies, while retaining full width and strength, give constantly decreasing copper values with added depth. The deepest shaft in the Butte district is now down nearly a half mile, and, excepting the chalcocite in the Never Sweat, the percentage of copper decreases in a fairly steady ratio as depth is gained. The Anaconda, which started with 55 per cent ore, is now averaging but a little over 3 per cent copper. There are still lower grade deposits of immense area in the district, as at the Modoc mine of the Anaconda and elsewhere, and in view of the great improvements in metallurgical processes made during the past decade, such ores may be used eventually. While Butte is most distinctly working into a lower grade camp each year, it must not be inferred that the high grade ores are exhausted. All of the big mines have considerable reserves of rich ore, other high grade ores are locked up by litigation, and still others are being developed every year.

Mining developments of the past two years in the flat east of the city indicate that the productive area of the district will be greatly increased, and possibly doubled, in the future. While Butte is no longer the high grade camp of ten years ago, and at least one of its great mines has probably passed its zenith, the district is by no means decadent. It is not likely that any man now living will survive to see the last ton of copper made by Butte mines, nor even live long enough to draw the last dividend paid by a Butte copper mine.

**NEVADA.** The development of silver mines of fabulous richness, coupled with political exigencies, brought Nevada into statehood, some forty years ago. Beyond working the silver bonanzas along the extreme western edge of the state, there was little mining development attempted, though prospectors brought in reports of rich discoveries from every county. Lack of railroad lines, coupled with a sparse population and mountainous topography, discouraged exploration, and for these, and possibly other reasons, Nevada has received less attention from the miner than any other of the western mining states. Of late this old order of things seems to be changing, and better times are in store.

Copper ore is reported from the counties of Elko, Esmerelda, Eureka, Humboldt, Lander, Lincoln, Nye, Storey and White Pine. Mines are now being developed, and while operations are upon a rather small scale at most of them, promising properties are being opened in several cases. The state is still most inadequately supplied with railroads, wagon-roads and people, and these drawbacks will deter the development of copper mines until partially overcome, but it is probable that the future will see an increasing interest in the mining of copper, as well as of gold and other metals, especially as Nevada lies between California and Utah, two of the richest mineral states of the Union, and the general geological conditions are much the same in these states and Arizona as in Nevada.

**NEW HAMPSHIRE.** Copper ores are noted at a number of points in this state, more especially in Grafton county. There are also deposits of apparently considerable extent in the Mt. Gardner district, near Woodsville, and chalcopyrite has been found at other points, including Franconia in the White Mountains, where the ore occurs in gneiss.

**NEW JERSEY.** The first copper mine in the United States was opened in New Jersey, and this, the old Schuyler mine, discovered in 1719, is now being worked by the Arlington Copper Company. The Schuyler was worked upon what was considered a large scale in those days, and made its owner wealthy. Work was suspended when the Revolutionary War begun, and the mine has never been steadily worked since that time, although it has been operated spasmodically on several occasions.

Ore deposits of low grade are found at a number of points in this state, and there is considerable native copper in the vicinity of Somerville, Flemington and New Brunswick. There are also old copper mines at Belleville, Griggstown and New Brunswick, most of which were small and unsuccessful. As the known deposits of ore and native copper in this state are of low grade, it is obvious that success can be secured only by the operation of mines upon a fairly large scale.

**NEW MEXICO.** Native copper has been found in the Santa Rita mines of Grant county, and copper ores are found at many points in the state, having been noted in considerable quantities in the counties of Grant, Lincoln, Rio Arriba, Santa Fe, Sierra, Socorro and Taos. General geological conditions are favorable to the finding of profitable mines, and there are several properties of considerable magnitude and good promise, notably the Aberdeen, at Lordsburg, which is a dividend-payer, the Santa Fe, Santa Rita and others. There is much prospecting for copper in progress, and a number of mines are being opened in the various counties. New Mexico has had a rather poor standing among mining men for the past fifteen or twenty years, due to some large failures scored in the territory in early copper mining ventures, but these seem to have been the fault of general conditions rather than to have come from the lack of ore. The first mining ventures were carried on under great disadvantages, and it is unfair to the territory as a whole to condemn it because of the failures of a few mines. There are many more failures than successes, even in the best copper mining districts of any state or country, and in the neighborhood of the greatest successes will nearly always be found the biggest failures.

**NEW YORK.** The Empire State has no copper mines, although copper ores have been found at a number of points. Chalcopyrite is found at the Ancram and Beckee lead mines in Columbia county; at Ellenville and the Red Bridge lead mines in Ulster county; with arsenopyrite near Wurtsboro, Sullivan county; in Chester, Warren county; Eastchester, Westchester county; Crown Point, Essex county; Alexandria and Antwerp, Jefferson county; Salisbury, Herkimer county, and at Canton, Fowler and the Rossie iron mines in St. Lawrence county. Malachite and cuprite occur at Ladentown, Rockland county, occuring in thin seams in the trap, and azurite, malachite and chalcopyrite have been found near Ossining, Westchester county.

**NORTH CAROLINA.** This is an important state, rich in mineral resources, and although it has never been a considerable producer of copper, may become such in the future, as its ore measures are of large extent and decidedly promising at some points. The state had several small copper mines in regular operation before the Civil War, and has been a regular though small producer of the metal for some years past. In view of the present interest in copper mining in this state it seems probable that the production will be increased by the making of several mines of fair size.

So far as can be determined by the limited geological research given many of the counties, and the developments to date, the most important copper measures of the state are contained in the counties of Ashe, Rowan, Person, Cabarrus and Granville, but copper ores are also found in the counties of Alexander, Alleghany, Caldwell, Catawba, Chatham, Clay, Davidson, Gaston, Guilford, Jackson, Lincoln, Madison, Mecklenburg, Mitchell, Montgomery, Moore, Rockingham, Swain, Transylvania, Watauga, Wilkes and Yadkin, and very possibly in several others as well. The ores are mainly sulphides, considerable chalcocite being found in Ashe and adjoining counties, but native copper has been found at the McCulloch mine in Guilford county, and all of the commercial ores of copper are found in the state, as well as a long list of the minor ores. The variety of copper minerals noted in North Carolina is probably nearly or quite as great as in Arizona.

The Virgilina district, on the border of Virginia and North Carolina, and including the counties of Person and Granville in the latter-named state, has sulphide ores occurring in lenses longitudinally, and apparently in series vertically, as proven by developments to about 300 feet in depth. The Virgilina district is in the sub-Piedemont division of the Appalachian belt, and in the same division, considerably further south, is found the Gold Hill district, where there has been considerable development, and where the ores apparently hold their full values to the greatest depth reached, which is slightly under 1,000 feet, the ore running 1 to 10 per cent copper, 2 to 4 ounces silver and about $2 per ton in gold. The area of the Gold Hill field, as far as determined, is about 25 miles in length by one mile in width. The chalcopyrite occurs in quartz and a decomposed schist.

**OHIO.** Native copper nuggets brought down from Lake Superior by glacial action are frequently found in the drift in this state, and native copper nuggets and ornaments are taken from the mounds built by a prehistoric race, but such occurrences are not of industrial value, and are of but slight geological interest. So far as reported, no trace is found of any copper deposits in place in the state.

**OKLAHOMA.** Copper ore has been found in small quantities at several points in this territory, but so far as known none of the discoveries are of much promise. A little excitement was caused late in 1901 by the finding of copper ores in the hills of Wood and Woodward counties, but nothing came of the discoveries.

**OREGON.** Copper ores are found in a number of districts in this state, notably in the counties of Baker, Grant and Josephine. The St. Helens district is regarded as of promise. In Josephine county, just north of the California line, the copper belt of that state continues into Oregon, general conditions being similar to those in Del Norte county, California. The Dietrick district in Josephine county is the scene of some little activity in copper development at present, The ore in this district carries good values in gold and silver, as well as high percentages of copper, and the veins are said to be of good width. The Burkemont district is in eastern Oregon, and is apparently a continuation of the Seven Devils district of western Idaho, which it adjoins. There are considerable bodies of low-grade ore in this district, and it is evident that profitable mines can be made only by large development and the steady production of a large ore tonnage.

**PENNSYLVANIA.** Although copper mining was undertaken in Pennsylvania more than a hundred years ago, the state yet lacks a copper mine. The earliest attempt in this line was at the Gap mine, in Lancaster county, which was opened as a copper mine in the eighteenth century, and was a failure as such, but was reopened as a nickel mine about 1850, and was successfully operated for that metal, with a small incidental production of copper, until 1893, when the richer mines of the Sudbury district of Ontario brought about a fall in the price of nickel that closed the Gap. There are copper ores at a number of points, mostly in small quantities. Native copper, chalcopyrite, azurite, malachite, chrysocolla, cuprite and brochantite are found at Cornwall, Lebanon county. The Perkiomen mine in Montgomery shows as long a list of copper minerals. In an abandoned lead mine at Schuylkill, Chester county, a variety of ores and native copper occur, and chalcopyrite is found in the Elizabeth mine at Norwich, in the same county. Native copper and cuprite have been found near Gettysburg. Native copper, malachite, chrysocolla, chalcopyrite, cuprite, melaconite and aurichalcite occur at Jones's mine, Morgantown, Bucks county, and malachite has been found at New Britain in the same county. Oxide, carbonate, sulphide and silicate ores have been found in small quantities in the quarries of Frankford, a suburb of Philadelphia. Bornite has been found in York county, and sundry ores are reported from Montgomery county. A little prospecting for copper has been done during 1902 in Pottstown and also at Tunkhannock.

**RHODE ISLAND.** There are no mines of copper in this little state, but chalcopyrite ore is found at Portsmouth, and malachite, azurite, bornite and chalcopyrite occur at Cumberland, while malachite, azurite and chalcopyrite have been found at Johnston.

**SOUTH CAROLINA.** Chalcopyrite has been found in the Fair Forest gold mines, in Union county, but, so far as known, there are no copper deposits giving promise of making mines within the limits of the state.

**SOUTH DAKOTA.** In the southwest corner of the state of South Dakota, arising from an extensive plain and isolated geologically, is the peculiar mountainous region known as the Black Hills. These mountains are a veritable storehouse of nature's mineral wealth, and there are but few metals not found here in greater or less profusion. The presence of copper was noted by early explorers, but in the all-consuming search for gold the other metals were neglected until a few years ago. Copper ores are in demand at the local smelters for use as fluxes in reducing refractory gold ores, being preferable to the barren fluxes that would otherwise be necessary. Geologically, the copper measures of the Black Hills have been compared by several scientific observers with those of the Ducktown district of Tennessee. The principal mining developments have been made in Pennington county, where several copper mines are now being developed.

**TENNESSEE.** The proven copper deposits of Tennessee occur in Polk county, in the extreme southeastern corner of the state, although the discovery of high-grade copper ore was reported from Lawrence county late in 1902. A little native copper is found in the Ducktown mines, but the important source of supply is chalcopyrite. The Ducktown district was discovered circa 1840, and as early as 1854 there were two blast furnaces in operation at that point. A thriving industry had been built up and the prosperity of the district seemed assured when the Civil War brought mining and smelting to a standstill, and work was not resumed until some years after the war, and then in a small way only. A British syndicate did the first post-bellum work, and has been followed by a strong American company. The copper industry of the Ducktown district seems to be on an assured footing again, with every prospect of growth in the future.

**TEXAS.** A little native copper is found in Burnet and Llano counties, and there are ores of chalcopyrite in both counties, as well as argentiferous tetrahedrite in the latter. Carbonate and silicate ores are exposed at a number of points along the Brazos river, in the Permian sandstones. Malachite and azurite,also chalcopyrite and bornite, in a quartz gangue, have been found in a prospecting shaft four miles north of Llano, the ores carrying 0.11 ounces of gold and 2.5 ounces silver per ton. A hand-picked sample of tetrahedrite from Babyhead Mountain, Llano county, gave 107.8 ounces silver and 6.4% copper. The White Eagle Copper Company, operating in Burnet county, has developed a mine by shaft and an open cut. It is probable that copper ores will also be found in several other counties of the Texas mineral zone.

**UTAH.** Copper has long been produced from Utah mines, but until quite recently the metal has been obtained only as a by-product from the smelting of gold and silver ores. With the development of the Utah and Bingham mines of the West Mountain district of Salt Lake county, a new era has been entered upon, and Utah's copper output is increasing rapidly. The principal producers are in Salt Lake county, but there are very promising properties in process of development in Beaver county, and there are also copper ores and occasional exploitations in the counties of Juab, Piute, Summit and Tooele.

The mines of the West Mountain district are of exceptional promise, and are already considerable producers. All of them carry gold and silver in sufficient quantities to materially reduce the cost of copper production, and greater attention is being paid to copper-bearing veins in the older mines, some of which are proving valuable. Some of the properties in Beaver county are among the most promising to be found anywhere, at a similar stage of development. Utah has long been one of the solid mining states of the Union, and its mines, largely developed and owned by local capital, until within the past few years, have an enviable record of dividends, Some of the newer copper mines of Utah are in a position to make copper so cheaply, owing to the gold and silver secured as by-products, that Utah must be included in any possible list of the important copper-producing districts of the world.

**VERMONT.** There are deposits of chalcopyrite at South Strafford, Vershire, Waterbury, Shrewsbury, Berkshire and Corinth in this state, and copper mines have been operated in the past in three districts, at Vershire, South Strafford and Berkshire. The Ely mine had a smelter at Vershire circa 1861-1870, and worked with more or less regularity, but was forced to go out of business by the greatly decreased price of copper following the Civil War. The Elizabeth mine at South Strafford and the Ely mine at Vershire are now in the hands of George Westinghouse, of Pittsburg, and a limited production was effected in 1901-1902 from the Elizabeth, where about one hundred men were worked, while the Ely is being reopened and put in readiness for production. The other mines are idle. The Vermont ore is chiefly chalcopyrite, ranging from 3% to 30% copper, with an average of probably 5% to 10%.

**VIRGINIA.** Virginia has an auriferous-cupriferous mineral belt, stretching from the Piedemont district in Orange county to the North Carolina line. Copper ore has been noted in the counties of Buckingham, Carroll, Grayson, Fauquier, Fluvanna, Franklin, Greene, Halifax, Loudoun, Louisa, Montgomery, Nelson, Orange, and Polk. There are copper mines of small extent in Fauquier and possibly in other counties of the state, but the largest mines and principal development are found in Halifax county. The Virgilina district lies in both Virginia and North Carolina, the Virginia portion being in the county of Halifax. This district, as developed, is about twenty miles long by three miles wide, with indications of copper beyond these boundaries. The ores are chalcocite and bornite in a quartz gangue, and average possibly no more than 3%, though having frequent chutes running 20% to 30% copper. The ores of this district, as mined, average about one dollar gold and six to ten ounces silver per ton, and, with their gangue, run from 4 to 10 feet in width. There are fourteen mines in this district, of which four are producers, with the others developing or idle. The advantages enjoyed by the mines of the Virgilina district are cheap fuel and labor, an equable climate and proximity to the Atlantic seaboard, with which there is good rail communication. Several strong companies are now operating in this field, and it is likely to be heard from in the future as a considerable producer, the gold and silver values being sufficient to permit the operation of low-grade and narrow ore bodies that would otherwise offer little promise of adequate returns.

**WASHINGTON.** There are copper deposits in King, Stevens and other counties of this state, and a little attention is being paid to copper mining at present. None of the mines have yet advanced to a stage where it is possible to predict a certain future, but some promising prospects are under development.

**WISCONSIN.** There are copper ores in the zinc and lead district of southwestern Wisconsin in the vicinity of Shullsburg and Mineral Point, and some crude attempts at mining copper have been made at the latter-named town. Chalcopyrite and malachite have been found in Sauk county, and in 1902 a diamond drill boring north of Osceola gave cores assaying well in copper and with small values in gold and silver.

The northern fold of the Keweenawan trap formation extends across the Lake Superior shore of northern Wisconsin from Bayfield to the Minnesota line, carrying more or less native copper in the mineralized amygdaloids. This formation is described in the article on Michigan. A number of small shafts have been sunk on this fold of the Keweenaw formation, in Douglas county, but no mines have resulted from the work. The most extensive work was done at the Chippewa property, which came to grief financially late in 1902. A recent development, which is apparently much the most important ever made in the state, is noted in the southern end of Douglas county, where the Minong Range Copper Company is sinking two shafts in an amygdaloid. The importance of this work lies in the fact that the formation dips northward at this point, showing that the shafts are on the southern fold of the synclinal, this being the fold on which all the profitable mines of Lake Superior native copper have been opened, all mines on the northern fold having proved failures. Considerable heavy copper has been secured in one of these shafts, and the outcome will be awaited with interest, as the making of a paying mine at this point would treble the area of the possibly profitable zone of the Lake Superior copper field.

**WYOMING.** Although Wyoming is one of the newest copper fields of the United States it is by no means least in promise, and the Grand Encampment district has attracted wide attention, as well as the investment of large amounts of money. I am indebted mainly to Prof. Henry C. Beeler, state geologist, for the facts in the following summary of Wyoming copper deposits and prospects.

The principal cupriferous field of the state is the Grand Encampment district, having an estimated area of 2,500 miles, and lying in the southern half of Carbon county and the southwestern quarter of Albany county. The district is divided in two nearly equal parts by the North Platte river, and has the Sierra Madre Mountains to the west and the Medicine Bow range on the east. Encampment is the principal town of the district. While there were known to be promising mineral indications, little was accomplished until 1898, when gold prospecting begun. This was not especially successful, but copper prospects were located soon thereafter, and there has been increasing interest since then in copper development.

The general formation of the Sierra Madre is an irregular core of red granite, with fine-grained mica-hornblende schists of Algonkian age lying thereupon. Both schists and granite are cut at intervals by dykes of diorite and associated dyke rocks, the dykes running in apparent conformity with the strike and dip of the schists when traversing them. Associated with the schists and conformable in strike and dip are huge ledges of quartzite and altered schists known locally as lime dykes, the alterative material having been mainly lime, with some silica. Extensive evidences of replacement and alteration are frequently noted in the granite and diorite, as well as in the schists.

While the formations in general are fairly mineralized the principal ore bodies are found in the contacts between the schists and adjacent rocks, especially so in the contacts of schists and quartzite. The outcrops are usually of soft spongy limonite carrying some hematite, and often show a little quartz in the ore. These outcrops are noted on veins ranging from mere stringers to a width of 20 feet or more, and extend to water level, a depth of 35 to 100 feet. The iron oxides are usually associated with copper carbonates, the percentage of copper being small at surface and increasing with depth. A little chalcocite is found in the zone of secondary enrichment, but at or about the water level the ores change to chalcopyrite and bornite. Above the water level the altered ores are mainly malachite and azurite, with a little native copper. In several instances the outcrops are fairly pure specular or silicious hematite, associated with white quartz. In the cases where copper sulphides outcrop the same white quartz is found in association.

The district has been a producer since 1900, ores shipped assaying 30% to 49% in carload lots. This necessitated hand-selection and the rejection of the lower-grade ores. The high-grade ores carry $8 to $10 per ton in gold and silver. The district has a smelter which handles mainly low-grade ores, the product therefrom being shipped as high-grade matte. An interesting feature of this district is an aerial tram 16 miles long, in four sections, running from the Ferris-Haggerty mine to the Encampment smelter, this being in successful operation.

The Medicine Bow range on the eastern side of the Encampment district has been prospected for years, mostly for gold, of which little has been found. In 1900 the Great Rambler mine, opened and abandoned as a gold property, was relocated for copper, and begun shipping ore at once. An interesting feature of this property is the finding of platinum in commercial quantities. The general formation of the Medicine Bow range is a gray and red granite, flanked more or less irregularly by schists and gneisses, with dykes similar to the Encampment district as before described. The Rambler is evidently opened in fissures in the black, dioritic granite, but its upper workings show alteration conditions similar to those prevailing to the westward.

Among the other copper districts of the state is the Laramie Hills, running along the southern state line from Laramie through Albany and Converse counties to Caspar, Natrona county. The formation is a granite core with north and south trend, flanked by schists and succeeding sedimentary formations. Copper is found native in red disintegrated granite at Sherman Hill, and as sulphide ores in prospects at Hecla, Slate Creek, Cooney Hill and to the northward of Laramie Peak. Copper ores have also been found in the Big Horn Mountains and in the Wind river districts, under conditions resembling those of the Grand Encampment district, though little development has yet been attempted on any discoveries in the two last-named districts.

The copper properties of the Encampment district are obviously of more than average promise, the richness of their ores and the considerable values carried in the precious metals enabling owners to develop properties from shipments secured near surface. The alteration zone is of shallow depth, however, and the ultimate value of the district must be determined by the values secured from the unaltered sulphides, on which little work has yet been done. The oxidized ores, however, will enable many owners to give their mines thorough tests at small cost.

# CHAPTER VIII.

## COPPER DEPOSITS OF CANADA AND NEWFOUNDLAND.

In this chapter the copper deposits of Canada are treated in detail, by provinces, and for geographical convenience, Newfoundland is added, although Newfoundland has never become a part of the Dominion of Canada.

While the metal has been mined for many years in the eastern provinces of the dominion, the Canadian copper industry was never of importance previous to the exploitation of the great nickel-copper deposits of the Sudbury district, in the middle eighties. Since that time the British Columbian fields have become prominent as producers, and the copper industry of Canada is apparently but in its infancy. The dominion must be included in any list of the principal copper producing countries of the future.

**NOVA SCOTIA.** Native copper is found in this province in the counties of Annapolis, Cumberland, Digby and elsewhere, while copper ores are noted in the county of Anitgonish, near Sidney, and at New Annan, Cape Breton, Colchester, Cumberland, Pictou and Sidney. The ores are mainly sulphides, and at Briar Island, Digby county, the native copper is found in grains in amygdaloidal trap, under circumstances similar to the occurrence of the native metal in the Lake Superior copper district. The Cape Breton deposits are of chalcopyrite, and carry both gold and silver, the ore having a silicious gangue and traversing diorite and felsite rocks.

Present developments in Nova Scotia are mainly in Cumberland and Cape Breton counties. The old Coxheath mines at Coxheath, Cape Breton county, are being operated, while other mines are being developed at Cape d'Or and Wentworth, in Cumberland county.

**NEW BRUNSWICK.** Copper ores are found in this province in the counties of Carleton, Charlotte, Gloucester and St. John, and native copper is found in certain of the older sandstones. There has been a renewal of interest in the copper deposits of New Brunswick within the past five years, and mines are now being developed at several points. While no striking successes have been scored as yet, there are several properties with good prospects, and it is hoped that some good mines may result from the work now being done.

**QUEBEC.** In this province copper ores have been found in the counties of Arthabaska, Bagot, Beauçe, Brome, Dorchester, Drummond, Levis, Lotbiniere, Megantic, Missisquoi, Richmond, Sherbrooke, Shefford and Wolfe, and also on the north shore of the Gulf of St. Lawrence in the district of Saguenay. Mines have been opened at various times and points in several of these counties, but the principal development has been at Capelton, in the little county of Sherbrooke, just above the New England border. The ores, like those of Ontario, are mostly chalcopyrite, and invariably so where found in quantities sufficient to justify the opening of mines. The sulphide ores of copper are frequently found in conjunction with pyrite and pyrrhotite, and are sometimes developed in mines first opened for pyrite destined for the manufacture of acids. The principal mines have been opened in limestone, near the point of contact with serpentine and diorite rocks, the limestones being more or less closely associated with slates. The Capelton mines carry 3 to 4 per cent. copper and 3 to 4 ounces of silver per ton. The sulphur from these mines is saved, as far as possible, for the making of acid.

**ONTARIO.** There are copper ores in this province at many different points, and at some of them large mines are opened, while in others mines are developing, and in still others mining work is confined to the merest prospecting. Ontario is a large province, and has a great diversity of topography and geological conditions, its frontier marching with New York in the east and Minnesota on the west.

Copper is found native at several points, but mainly as sulphide ores, and in the Sudbury district the iron-sulphide ores of copper are highly nickeliferous, so much so that this district furnishes more than half of the nickel supply of the world. As a rule the oxide and carbonate ores of the alteration zone are missing in Ontario, the unaltered iron sulphides, mainly chalcopyrite, with a little bornite, reaching to surface with slight traces of change.

The first copper mining in the province was undertaken at the Bruce mines, on the northern shore of Georgian Bay, in 1846, immediately after the opening of the first Lake Superior native copper mines of Michigan. After many years of idleness these mines are now being reopened. The first really important production of the metal after the suspension of work at Bruce Mines came from the discovery of the nickel-copper ores of Sudbury, in 1883, and their development. The ores of the Sudbury district are nickel-copper-iron sulphides, occurring in a country rock of diorite. Mines have been opened at various points in a district several miles square, in the vicinity of Sudbury and Copper Cliff. This district is a fairly large and increasing producer of copper, but, like all other good districts, has its wild-cats and failures, as well as its bonanzas.

Copper is also found in Lanark county, and in the Nipissing district. In the Parry Sound district there are numerous occurrences of the ore, the mineralized belt being of considerable area. This district is located along Parry Sound, on the east-central part of Georgian Bay. The geology of the district is as yet unsettled by the scientists, considerable differences of opinion existing among the various observers. The prevailing rock-forms of the district are gneisses and schists, and the formation shows marked flexion and faulting. There are numerous small quartz veins and frequent pegmatite dykes of large size and great persistence. The topography is rough and much of the rock is utterly devoid of vegetation or covering of any sort, the bald knobs alternating with marshes and swales in the lower ground. The mineralized zone is apparently about a quarter-mile in width with a generally northeasterly and southwesterly trend, and has been prospected for about twelve miles. The ore occurs as extended and approximately parallel lenses with a general trend in line with the mineral belt, and the ore bodies are frequently capped with gossan. The ore, as a rule, is chalcopyrite, with a little bornite and occasional chalcocite, and is auriferous, gold values running $3 to $10 per ton in many cases. Some of the beds are nickeliferous also, the nickel running as high as 2.5 per cent. in some instances.

The district of Algoma, which is very extensive, has copper deposits at a number of points, of which the principal, judged by past development, is in the Bruce Mines district of Georgian Bay. This field also includes the Rock Lake district, sixteen miles distant, where one large mine has been opened and a number of smaller properties are developing. The ores are chalcopyrite in a gangue of quartz, apparently in true fissure veins giving every evidence of permanency. In the Goulais Bay district, north of Sault Ste. Marie, several promising prospects are in process of development. On the northern mainland of Lake Superior, to the eastward of Michipicoten Island, there are sulphide ores of which little is known, beyond the fact of their existence. On the island itself there are amygdaloid strata carrying native copper, this being the easternmost outlier of the Keweenawan formation of the western half of Lake Superior. Various attempts at opening mines on these beds of native copper have proven unsuccessful. Chalcopyrite, chalcocite and domeykite have also been found on this island, in small quantities.

On the northern shore of Lake Superior, east of Thunder Bay, native copper is found on Battle Island and St. Ignace Island in Nepigon Bay, and at Pointe-aux-Mines. Chalcocite occurs on Spar Island, and chalcocite and malachite are found on Silver Islet. In the Thunder Bay district chalcopyrite occurs at Neebing, and a little development has been made at Black Bay and Shebandowan Lake, on native copper in trappean rocks.

In the Rainy River district sulphide ores have been found at several points.

**MANITOBA.** The province of Manitoba is an agricultural rather than a mining district, but there is a small area of mineral land along the eastern boundary, near Lake of the Woods. A vein, running 18 to 20 inches wide, occurring as a contact between granite and trap, and traceable for a half-mile, has been slightly prospected at Ingolf station, very near the Ontario boundary. This is a pyrrhotite carrying copper, nickel and traces of gold.

**BRITISH COLUMBIA.** This Canadian province is a kingdom in both area and resources. Its wealth of timber and mineral has been merely scratched, and the development of the past decade, while very great, both actually and relatively, is but the precursor of a far greater work to be accomplished in the future.

The first mining was on placers, for gold, nearly half a century ago. When the placers were exhausted the mining industry languished until the completion of the Canadian Pacific railroad through to the west coast, when permanent mining began in a small way. The first mines were of gold and silver, lead becoming an important product a little later. When the mines of the Trail creek and Boundary districts were opened, less than ten years ago, it was soon found that many of the mines carried considerable copper values. The bulk of the copper production of British Columbia is secured as a by-product from mines of gold, silver and lead, but several exclusively copper mines have been developed. A peculiarity of British Columbian mines—and by no means a disadvantageous one—is that the gold and silver mines usually carry more or less lead and copper, while the copper mines have appreciable values in gold and silver.

There is more or less copper in practically every mining district into which the province is divided, but the mines of the Boundary, Trail and Coast divisions lead in output. The relative importance of the various districts as producers is shown by the following official table of production of refined copper in 1901.

| Districts. | Production in Pounds. |
|---|---|
| Boundary | 14,511,787 |
| Trail (Rossland) | 8,333,446 |
| Coast | 3,115,872 |
| Nelson | 1,599,449 |
| All others | 43,192 |

From the trivial output from the districts lumped together under the caption "all others," it must not be inferred that they are of no importance. Many mines of good promise are found in these districts, but lack of development and adequate transportation lines is responsible for small production.

British Columbia now has a number of smelters, all new and mostly large and modern. Excellent results are being secured at many of these, and Wm. Fleet Robertson, provincial mineralogist, estimates that the cost of smelting copper has been reduced as low as $1.35 to $1.50 per ton of ore. These figures are astounding, and coming from a less eminent and accurate source would be received with suspicion.

**NEWFOUNDLAND.** There are sulphide ores of copper at many points in this island, and native copper has been found in place in stratified archaic rocks, under conditions resembling those governing in the Lake Superior district, on Odorin Island in Placentia Bay, and elsewhere. One mass of native metal weighing 55 pounds has been found, and the geological horizon of the district in which these occurrences of the native metal are noted is apparently about the same as that of the Keweenawan district of Michigan.

The first mining in Newfoundland was done in 1862, at the Tilt Cove mine, which was reopened in 1887 by the Cape Copper Co., its present owner. There are also other copper mines on the island that have been worked to some little extent, among these being the Little Bay, which has reached a depth of 1,350 feet, the Lady Pond, Betts Cove, York Harbour and others.

# CHAPTER IX.

## COPPER DEPOSITS OF MEXICO, CENTRAL AMERICA AND THE ANTILLES.

Under the heading of this chapter are grouped the Latin countries and islands of North America. With the exception of Mexico, which is a copper field of the first magnitude, and with the possible exception of Cuba, where there was once a considerable industry in the mining and smelting of copper ores, the developments noted in this chapter are of comparatively little importance.

**MEXICO.** The Republic of Mexico has made relatively greater strides in copper production during the past five years than any other country in the world. Not only has there been a most remarkable relative gain, but the actual gain in output puts Mexico an exceedingly close second to the United States in point of increase. That Mexico will soon lead Spain, and rank second only to the United States, seems assured. The Boleo has long been an important mine, but the copper production of all other Mexican mines was but 1,200 tons so recently as 1896. Since that time the Greene, Inguaran, Candela, Moctezuma, and other great properties have been developed. Those interested in copper will do well to keep an eye on Mexico for the next few years.

Copper in almost every known form is found in some part of the republic. The ore measures are extensive and include many different types of deposits. Argentiferous copper ores are frequently found in the crystalline slates of the Azoic group, a typical example being the district south of Puebla. Copper accompanied by hematite is noted in cretaceous beds of the Mesozoic, while in the Cenozoic group copper is found in regular veins in hornblendic andesites of the Pliocene system, also in the stratified beds of sedimentary rocks of the upper Miocene and lower Pliocene, the Boleo mine in Lower California being an example.

According to the official figures furnished by the Minister de Fomento, the number of copper mines and cupriferous mines within the boundaries of the republic was as follows on July 30, 1899: Mines of copper only, 221, with an area of 2,184 hectares; of copper and lead, 5 mines, with an area of 31 hectares; copper and gold, 69 mines with 857 hectares; copper and iron, 23 mines with 159 hectares; copper and silver, 192 with 1,637 hectares; copper, silver and gold, 55, with 896 hectares; copper, silver and lead, 12, with 147 hectares. This gives a total of 577 cupriferous mines, and an area of 5,911 hectares, out of a total of 8,970 mines of all classes having an area of 84,557 hectares in the entire republic. Taking into consideration the marvelous development of the three and a half years that have elapsed since the date of these statistics, it seems probable that the number of cupriferous mines in the republic is materially larger, unless the process of consolidation has absorbed more old mines than would offset the new openings. According to the summary of S. Chapman, F. S. S., made from the Mexican government's Boletin de Estadistica Fiscal—date not given—the number of cupriferous mines in the republic is materially greater than the figure first quoted. Chapman's summary gives a total of no less than 839 copper mines of all classes, of which 281 are mines of copper only, the balance producing other minerals as well as copper.

Nearly every state and territory of the republic has copper mines, the roster including the states of Aguascalientes, Chiapas, Chihuahua, Coahuila, Colima, Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, Michoacan, Morelos, Nueva Leon, Oaxaca, Puebla, Queretaro, San Luis Potosi, Sinaloa, Sonora, Tamaulipas, Vera Cruz and Zacatecas, also the territories of Tepic and Baja California, and the Federal District of Mexico. In point of output Sonora easily leads at present, with Lower California a good second. The more important developments in the other states are in Chihuahua, Michoacan, Durango, Coahuila, Guerrero and Zacatecas, though there is considerable activity in many of the other states, capital having been poured into Mexican copper mines by the tens of millions of dollars during the past five years. Under the strong but equable administration of President Diaz, Mexico has undergone a transformation during the past two decades. There are as ample safeguards for life and property as may be found in any part of Europe or the United States. The laws are administered constitutionally, rather than dictatorially, and the president has surrounded himself by statesmen of ability and honesty, under whose fostering care Mexico has become one of the favorite fields of investment for the surplus capital of Europe and America. While many failures have been scored, the percentage of successful mining investments made in this country of late years is unusually high.

Mexico has upwards of 300 smelters of all sorts, mostly very crude, but with a few of the most modern type and of immense size, notable among the latter being the fine plants of the American Smelting and Refining Company at Aguascalientes, Monterey and San Luis Potosi. There are also fine reduction plants at the Boleo, Greene Consolidated, Descubridora and other copper mines of the country.

The Sonoran copper deposits are of the Carboniferous system of the Paleozoic group. The principal districts of northern Sonora are La Cananea and Nacos. These are but a short distance south of the Arizona line, and the geological, geographical and climatological conditions are practically the same as in the Bisbee district of Arizona, or, rather, the Bisbee, Nacos and Cananea fields are one district, divided by the international boundary line, and these fields, considered as one district, have furnished perhaps the most important copper mining developments noted on the globe during the past five years. There are other promising districts in Sonora, where development work is in progress, but they have been overshadowed by the spectacular rise of the Cananea mines.

In Lower California there are some 30 copper mines of all classes, mostly insignificant, but the Boleo, operated by a French company, is a property of the first magnitude. This mine is opened on beds occurring in a formation of Tertiary sandstones, conglomerates and tufas. The cupriferous beds, three in number, of large area, lie upon conglomerates of varying horizons and are overlaid by argillaceous tufas, all traversed by fissures. In the upper bed, above the water level, the ores are disseminated oxidized ores, such as melaconite, cuprite, atacamite, azurite, malachite, crednerite and chrysocolla, all in quantities of commercial importance. In the second ore bed there are peculiar globular concretions of oxide and carbonate ores, called boleos, whence the name of the mine. The third bed, in addition to the oxide, carbonate, silicate and oxy-manganate ores, also carries sulphides, not the ordinary iron-sulphides, but chalcocite and covelline, the richest ores of copper. The ores are disseminated in irregular masses, veinlets and concretions, in a clayey tufa, with a marked tendency toward concentration upon the underlying conglomerates, where the ores occur compact in layers of 6 to 10 inches.

While Michoacan has not yet become a large producer, it has one very large property, the Inguaran, in process of development, and other properties of promise are also undergoing exploitation. The Ario district of Michoacan contains enormous bodies of sulphide ores, occurring quite evenly disseminated in granitic rock. It is obvious that these properties must be worked upon a very large scale to prove profitable, but as the Rothschilds are furnishing the money for the development of the largest mine, the district will receive the benefit of adequate capital in its development.

In the state of Coahuila there are several important mining developments. The same is true of Zacatecas and Durango. The state of Chiapas has some rich gold-copper mines, especially in the neighborhood of Santa Fe and Pichu-Calco. In the state of Guerrero there are good copper ore bodies, and a newly organized American company is preparing to develop mines on a large scale, south of the Balsas river in the districts of Braves and Travares, less than 40 miles from Acapulco, which lies on the Pacific coast. The claims made for this property are simply staggering, and if they did not come from an apparently responsible source, would be laughed at as preposterous.

**COSTA RICA.** There are outcrops of copper ores at several points in the republic, but no attempt has ever been made at opening mines.

**CUBA.** Copper ores occur at many points in the eastern part of the republic, and the province of Santiago was the scene of the first copper mining done in the new world. El Cobre mines, situated some thirty miles north of the city of Santiago, in the Sierra Madre mountains, were opened in the Sixteenth century and were worked with more or less regularity until 1834, when the various mines of the district were bought by an English company and consolidated. From thence until 1868 the production averaged one million dollars in annual value. The richest ore was shipped direct to Swansea, while the low-grade ore was discarded and the medium quality reduced to matte for export to the smelters. The mines were opened to the depth of nearly a quarter of a mile and were equipped with excellent machinery and buildings. In the rebellion of 1868 the torch was applied by insurgents and the extensive plant entirely burned, since which time the mines have been idle, although a little copper has been obtained every year by natural cementation. Steps are now being taken for the reopening of these mines, which, in view of their past production and profits, are doubtless worthy of the great cost that their reopening and equipment will entail. There are also promising copper deposits in the province of Pinar del Rio, and elsewhere.

**GUATEMALA.** Excellent specimens of sulphide copper ores have been found at various points in the republic of Guatemala, but no serious attempts have been made at developing these resources, and I am unable to find trace of anything worthy the name of a copper mine in the country.

**HAYTI.** Copper exists at several points in Hayti, notably in the Hotte Mountain range in the southern part of the country. Previous mining developments have been of the crudest, but an attempt is now being made, under American management, to open regular mines of copper.

**HONDURAS.** There is copper ore in nearly every department of the little Central American republic of Honduras, but the development of mineral industries is not equal to the possibilities offered, and the only copper producer worthy of the name is the Eureka mine, in Orica Basin, department of Tegucigalpa, where a small production of gold, silver and copper is effected.

**JAMAICA.** Small copper mines were opened at several places in Jamaica many years ago, but the ore bodies proved meagre, so far as exploited, and the mines, being unprofitable, were soon abandoned. There are indications of copper and other metals at many points on the island.

**NICARAGUA.** A very limited amount of copper is produced in Nicaragua as a by-product from the smelting of silver ores. There are promising undeveloped copper ores in the department of Nueva Segovia, the development of which is rendered difficult by a mountainous country and poor roads. There are also occurrences of copper ores in the departments of Leon, Jinotega and Matagalpa, and in the district of Prinzapulca.

**PORTO RICO.** Copper ores occur at several points on this island, but, so far as can be ascertained, no serious attempts have ever been made to develop mines thereon.

**SAN SALVADOR.** There are deposits of copper ore at several points in the republic of San Salvador, but efforts to secure details regarding them have not been rewarded as yet.

**SANTO DOMINGO.** There are copper, gold and silver ores in the San Francisco Mountains of the department of San Cristobal, and during the year 1900 concessions were issued to Señor Don Antonia Nascia for copper mining at Barrero, San Cristobal, to Señor Francisco Sezzato for copper mining in the same department, and to Señor Francisco Diaz for copper mining.

# CHAPTER X.

## COPPER DEPOSITS OF SOUTH AMERICA.

The various copper producing fields of this continent are treated alphabetically, by countries, in the pages of this chapter. The cupriferous mesures of South America are of vast extent and great value, though as yet having but comparatively small development, except in Chile.

**ARGENTINA.** The Cordilleran copper belt that traverses portions of Bolivia, Peru and Chile is also found in the Argentine Republic, on the eastern slope of the Andes, in the departments of Tucuman, Cordoba, San Juan, La Rioja and elsewhere, and several mines, notable among which are the Rosario, Carmelita and Restauradora, have been developed, but have never been extensive producers, owing to the primitive methods used in mining and smelting, and the even more primitive means of transport employed, thirty mules being required to carry a ton of ore from the mines to the smelter. A wire rope tramway discounts mule power for such uses. Under such adverse circumstances it is scarcely surprising that Argentina made only 76 metric tons of copper in 1900.

A recently discovered copper deposit near Los Morteros assays 40 to 50 per cent. copper and is said to be well located for economical operation. The principal copper developments within the limits of the republic have been in the Cerro de Capillitas district, where a mass of fissure veins, forming almost a gigantic stockwerk, occur in granite, gneiss and porphyry, with a capping of trachyte. The ores developed in this district are tenorite, cuprite, malachite and azurite, with some bornite and occasional argentiferous tetrahedrite. It is possible that chalcopyrite will come in at greater depth, but the richer ores in the alteration zone are evidently of considerable depth, and are both auriferous and argentiferous as a rule. An English company now owns a number of the best properties of the Cerro de Capillitas district and can scarcely miss making a rich mine, if the large sums necessary for roads and modern machinery are expended judiciously.

**BRAZIL.** The existence of native copper and copper ores in Brazil has been known for many years, but until very recently no systematic attempt has been made at mining, and no official records kept of discoveries and operations. In fact, no information whatever has been obtained from any of the government officials, on the subject of copper deposits.

A mass of native copper weighing 2,616 pounds was uncovered many years ago, in the neighborhood of Bahia, and now reposes in the royal museum at Lisbon. Copper ores have been found, from time to time, at various points in Brazil, among the more important localities of occurrence being Ouro Preto, Camaquan, Pelotas and various points in the state of Minas Geraes, which has long been noted for its large and profitable gold production. The only systematic work now under way in the republic is near Lavras, Minas Geraes, where a copper deposit found in the spring of 1901 gave assays running up to 75 per cent. metallic copper. This is owned by a company recently organized in Brussels, and thorough development is promised by the new owners.

**BOLIVIA.** The Andean copper belt of South America reaches through Argentina, Chile, Peru, and Bolivia, and general geological conditions are much the same in the cupriferous districts of all four countries. The exploitation of Bolivian copper mines has been hampered by lack of cheap and efficient transportation, and highly skilled labor is also hard to get and keep. All of the copper produced in this country is shipped through the Peruvian port of Mollendo.

The principal and at present the only active Bolivian copper mines are in the district of Coro Coro, department of La Paz. In this district there are two dissimilar sedimentary formations, apparently of different geologica periods, similar only in their origin and cupriferous nature. The older and underlying formation, " Las Vetas, " is an arenaceous conglomerate with argillaceous tendencies, having a northeasterly trend. Superimposed upon this statum is another conglomerate, " Los Ramos, " having a southwesterly trend. The upper conglomerate is much like the lower, but is darker in color and mottled with red and whitish particles of gypsum and other minerals not found in the older stratum. In many respects the La Paz field more closely resembles the Lake Superior copper district than any other. The country rocks are eruptive, mainly dioritic, and the copper is found native, as a rule, and only rarely as ores in quantities of commercial importance. Like the Calumet and Allouez conglomerates of the Lake Superior district, the Bolivian conglomerates carry the native metal in fine nodules, although masses, usually small, but sometimes very large, are occasionally encountered. Another point of resemblance is the occurrence of silver, always native, found associated with the copper, but never alloyed with it.

Next to La Paz, the most promising and farthest advanced district is that of Pacajos, where the output reached 1,000 quintals weekly in June of 1900. The same general conditions of labor and transportation govern in this district as in La Paz.

**CHILE.** Although Chile led the world in copper production about the beginning of the last quarter of the Nineteenth century, that country has lost ground as a producer, not only relatively, but actually. There is reason to believe, however, that the tide has turned, and the output for 1901 was the largest secured for many years. The secret of the sudden rise of Chile, its arrested progress, decline and final rejuvenation as a copper producer is found in the combination of geological, geographical and metallurgical conditions under which the copper industry had its birth, its period of prosperity, its decline and its renascence. There is copper ore in every province, and in nearly every district of every province of the republic. The ease with which the oxidized surface ores were secured and smelted gave rise to a large industry, but, like a fire of kindling wood, while quick and hot the industry was of short life, because the altered ores gave way at depth to the low-grade iron-sulphides. These are now being mined in increasing quantities, and the Chilean copper industry is more firmly established at present than at the height of its former prosperity, even though the annual production be smaller.

Copper deposits were worked in a limited way before the first white man set foot upon the soil of Chile. Under Spanish dominion a little copper was produced, but the industry did not begin to expand largely until the achievement of independence, about the third decade of the Nineteenth century, after which mining flourished greatly. Until 1842 the high-grade oxide and carbonate ores were smelted in charcoal furnaces, but in that year the first reverberatory furnace was built at Coquimbo, by C. Lambert, and in 1857 the first blast furnace was built by the same man. The period of greatest prosperity of the Chilean copper industry begun about 1850, and continued for nearly thirty years, after which there was a period of twenty years during which the industry lost ground slowly but steadily, this depression being followed by the beginning of better times, just at the close of the century. In 1881 Chile, Spain and the United States, the three greatest producers, made about the same amount of copper each, Chile having a slight lead with a trifle more than 41,000 long tons. From that point the output slowly declined to about 25,000 tons, fifteen years later.

Chile has two parallel copper belts, running nearly due north and south, and approximately one hundred miles apart. The principal development has been made in the western, or coastal belt, because of the greater ease of exploitation and transportation. The country rock of the Chilean cupriferous districts is composed mainly of strata of the Permian system, sandstones predominating. These have been extensively faulted, twisted, broken and upheaved by eruptive diorites. The general geological conditions are much the same as are found in the Mansfeld district of Germany, and in the governments of Perm and Elizabethpol in Russia. The Cordilleran belt, which lies back from the coast some distance in a country about as rugged as can be found anywhere, is so difficult of access, in most cases, that but little mining development has been secured, especially in the case of copper ores, on which the cost of transportation is so great as to preclude operations in any but the most favored districts. The two parallel copper-bearing belts stretch from Argentina on the south, into Peru on the northern boundary.

Summarizing from Prof. Ch. Vattier's excellent little brochure, "Mineria i Metalurjia de Chile," the principal copper-bearing districts of the country, as developed, are as follows, from south to north:

In the provinces of Santiago and Valparaiso is the mineral center of Las Condes, and the rich sulphide mines of Los Elguin, Bronces and Transito, with other centers of activity, as at Naltagua, Los Aguirre, Tiltil and Lampa.

In the province of Aconcagua are the well-known mines of Catemu, with the Melon group and other less-known properties. Lying next north comes the province of Coquimbo, ranking among the most important as a copper producer. The principal mines are in the departments of Combarbala, Illapel and Ovalle, including such first-rate mines as the Panulcillo and others less known. The province of Atacama is at present the greatest copper producer of the country. In the department of Vallenar there are numerous mines, among which are the Camarones and San Antonio. The department of Freirina is the location of the great Carrizal mines, upper and lower, and of other important producers. In the department of Copiapo are such great mines as the Dulcinea, Puquios, Nantojo and Tierra Amarilla. The department of Chañaral is the site of the great mines of the same name. The province of Antofagasta is among the greatest copper centers of the country, and has large and important mines in the departments of Taltal, where the mine Esploradora is located; in the neighborhood of Calama, department of Antofagasta, and in the department of Tocopilla.

The Cerro Blanco district is not on the coastal belt, but is located in the Cordilleran zone, the mines being opened principally in trachyte. These were originally opened for silver, but at the depth of about 600 feet a zone of rich copper-silver ore was encountered, and this, in turn, was succeeded at greater depth by unaltered iron-sulphides of good average values. The deepest mine of the district is the Agua Amarilla, which has reached a depth exceeding 1,500 feet.

Among the discouraging features of the Chilean copper trade, for the past twenty years, have been lack of railroads, inefficient labor, high wages and lessened values of ore bodies in the case of the older and deeper mines. Transportation facilities have been greatly improved during the past decade, the enlightened and progressive government of Chile having fostered railroad building, as well as taking a deep interest in the development of the mineral and other natural resources of the republic. General conditions are improving, slowly but surely, and Chile from now on should show gains in copper production. The resources of the republic in this mineral are scarcely excelled by any country except the United States.

**COLOMBIA.** While the republic of Colombia is noted for its production of gold and silver, little attention has been paid to mining for other than the precious metals. The existence of copper has long been known, but heretofore no attempts have been made at mining in any but the crudest manner, though small quantities of the rich oxidized ores near surface have been extracted at various points, from time to time.

Copper ores are known to exist in many departments, notable among which are Tolima, Rio Blanca, and Cauca. Among the principal deposits of Cauca are those of San Lorenzo, Yocoto, Coli, Pichinche and Andagueda. The principal mining districts of Colima are those of Anchique, Fiscal and Nacoroco, lying southwest of Natagaima. The International Colonizing

Company, of New York, has extensive concessions in this district, on which good bodies of copper ore have been located.

**ECUADOR.** While there are no working mines in this republic, the existence of copper ores at various points has long been known. One of the most recent and most important discoveries was made in 1900 in the province of Ahuay, about 35 miles from the coast, where a promising deposit of copper ore was discovered, at an elevation of about one mile above sea-level.

**PARAGUAY.** There are deposits of copper ore in the northern part of Paraguay, but details regarding the size, richness and probable value of the veins are not obtainable.

**PERU.** The rapidly growing copper industry of Peru suffered a rude shock in the decline of the metal's market price, and production fell off greatly during 1902. The very extensive operations put under way by the Cerro de Pasco company will result, within the next few years, in giving to Peru the largest and best equipped mining and smelting plant on the South American continent, and the example thus set is quite certain to have a highly beneficial effect on the Peruvian copper industry as a whole.

The Andean copper zone of Argentina, Chile and Bolivia is also found in Peru, and copper mines have been opened at a number of different points. According to the reports of the Minister de Fomento for 1900, there were 104 copper mines, an equal number of cupriferous silver mines and two mines of gold, silver and copper, within the boundaries of the republic. The government now has two surveying parties in the field, especially to delimit the copper-bearing districts, but their work will necessarily require a long time for completion. Mine owners furnish no reports to the government, and authenticated facts regarding the copper measures and copper mines of Peru are difficult to obtain from any source.

Peru was once a considerable producer of copper from various districts, but the industry fell into decay until late in the Nineteenth century, when there was a revival, stimulated by the high price of the metal. A limited amount of copper is produced as a by-product in the smelting of cupriferous silver ores. The principal mines of the republic are found in the four districts of Ica, Yauli, Acari and Cerro de Pasco, with minor properties in the districts of Mollendo, Moquega and Huarochiri.

The Ica district was once worked extensively, but was abandoned in 1892. Its largest mine is the Canza. The ores averaged about 30 per cent. copper, the lower grades being rejected. The drawbacks in this district are lack of water and good roads. The mines of Yauli, including the adjacent district of Morrococha, are located at an elevation of upwards of 13,000 feet above sea level. This field was once a considerable copper producer, but work was stopped for the same reason as in the Ica district. More or less silver is still mined, and some high grade copper ore averaging 26 per cent. in tenor is still being mined. The San Francisco is the principal mine of the Yauli district. The Acari district in the province of Camana has a number of small mines, but there is little activity at present. In the other minor districts conditions are practically the same.

The Cerro de Pasco district has always been the principal field of Peruvian copper production, and with the work now under way by the American company will speedily assume a commanding position, not only in Peru, but in all of South America. This district has been worked in a desultory fashion for 300 years, but serious development along modern lines was begun as recently as 1897. The district occupies a basin in the Cordilleras, at an elevation of 14,000 feet, and is most difficult of access. Unlike the other Peruvian fields, which are arid, there is an excess of water at Cerro de Pasco. The ores that have been worked hitherto have ranged in tenor from 25 to 40 per cent. copper. The lower grade ores, of which there are large bodies, have remained untouched, or were discarded after mining, only the richest ores being able to pay for the heavy costs of refining and transportation. The freight rate, for transportation on the backs of mules and llamas, is $40 per ton between the mines and Oroya, the terminus of the Meiggs railroad running from Callao into the Andes. The difficulty of getting out copper and getting in machinery and supplies, upon the backs of pack-animals, over the roughest of mountain trails, can only be understood by those that have had experience. The Cerro de Pasco company has secured control of the old Meiggs railroad, one of the engineering marvels of the world, and will continue the line to the mines from its present eastern terminus at Oroya. This extension was begun in the spring of 1901, and is proceeding uninterruptedly and successfully, though the problems to be met and overcome are certainly among the most stupendous ever attacked by courageous engineers. The expenditures of the company on the mines and railroad are already estimated at seven millions of dollars, and millions more must be devoted to the completion of the work. Fortunately there is no question of the ability of the company to raise any amount necessary.

**URUGUAY.** There is copper ore in Uruguay, but, so far as can be ascertained, there are no copper mines, and no serious attempt has ever been made at exploiting the copper deposits.

**VENEZUELA.** This country was once a considerable producer of copper, and is estimated to have made about 65,000 long tons of refined metal in the period 1872–1894, in which latter year the mines of the Aroa or Quebrada district were closed down. The principal cupriferous district of Venezuela is found on the Narvaez or Bolivar tract, between the Tocuyo river on the north and the Yaracuay on the south. This tract extends some 54 miles in an approximately east and west direction, comprising 1,150 square miles. These lands were granted to one Narvaez by the Spanish crown, in 1598, and in 1802 passed, by marriage, into the hands of Simon Bolivar, the liberator. This tract, on which a number of mines were opened, is now owned by a London syndicate. The mines of the Quebrada district, lying on the Aroa river, are included in the lands of this extensive estate. The igneous country rocks are of slate and limestone, with various intrusive rocks. Copper is found in lenticular masses, frequently of considerable size and unknown depth, the series of lenses having a strike nearly north and south. The ores are oxides and carbonates at and near surface, followed at slight depth by iron sulphides.

There are traditions that these mines were worked by the Indians before the coming of the Spanish. Early in the Nineteenth century, a Baltimore company operated several of the mines, and secured about 43,000 tons of high-grade carbonate and oxide ores. Later on Venezuelan capitalists took the mines and removed about 100,000 tons of high and medium grade ores. The Quebrada district will doubtless be given attention at some future time, but just at present political conditions in Venezuela are not satisfactory, and the enlistment of foreign capital, absolutely necessary for the development of the mines, is rendered difficult by the complaints of ill-treatment made by European and American moneyed men who have invested large sums in various mining and land enterprises in this republic.

# CHAPTER XI.

## COPPER DEPOSITS OF EUROPE.

Brief descriptions of the principal copper measures and developments of Europe are given, under the names of the respective countries possessing cupriferous deposits and mines, in this chapter, the titles being arranged alphabetically.

**AUSTRIA.** The total annual production of refined copper by Austria is about 2,000,000 pounds. Copper has been mined and smelted for hundreds of years, but none of the mines now active are worked on a large scale, and the mining and metallurgical plants are by no means modern in design.

Copper deposits are found in various parts of the empire, and mines are worked in a small way at several points, the principal of which is Kitzbuehel, in the Tyrol. There are other Tyrolean mines, all of quite insignificant production, and a few small producers at Salzburg. The Graslitz mine, in Bohemia, was a very large producer during the middle ages, but was abandoned in the Eighteenth century.

**BOSNIA.** Copper ores are mined in a small way at several points in Bosnia. Ore is mined and smelted at Sinjako, while the ores from other points are sent, in limited quantities, to Hungary for reduction. Bosnia and Herzegovina, which are under the protection of Austria, are usually lumped with the dual monarchy of Austria-Hungary in figures of production. The output for 1901 was 237 tons of refined copper, made from 4,747 tons of ore, of which 1,040 tons were fahlerz.

**BULGARIA.** There is ample evidence that mines of copper were worked within the present limits of Bulgaria during the days of Roman dominion, and possibly in even earlier times. At Plakalnitza, in the department of Vratza, there are considerable slag-piles from ancient smelters, dating from a time so remote that no vestiges of the works themselves are to be found, and in other departments of the principality there are similar but smaller slag-piles and waste-burrows of refuse containing traces of lean ore, the values of which have been effectually leached out by the rains of two thousand years.

At Plakalnitza the ore is mainly bornite, with a little malachite and chalcopyrite. At Kara Bair, near the port of Bourgos on the Black Sea, chalcopyrite is found in considerable profusion, and copper mines were evidently worked there at some remote period. At Milkiovtzy in the district of Trn, there are small deposits of chalcopyrite, chalcocite and malachite, in a barytic gangue. There is also chalcopyrite at Belogradchik, where some work is now being done. Chalcocite is found at Gornya-Banya and at other points in the department of Sofia, not far from the capital city, and in the districts of Sleven and Samokof native copper and oxide ores have been found.

**CORSICA.** There are a number of old copper mines in Corsica, of which one, the Lancone, was once a considerable producer.

**CYPRUS.** The Latin word cuprum, from which comes the English word copper, was derived from the name of this island, thus attesting its ancience as a source of copper. In ages long past there were extensive copper mines on the island, but the production at the present time is trivial, exports for 1899, the largest for some years, having been but 36 metric tons. One English corporation is now operating on the island.

**ENGLAND.** Copper and tin have been mined in Cornwall and Devon from very remote times, possibly for three thousand years. Oxide and carbonate ores occur in the conglomerates and sandstones of Cheshire, and these were once mined to some extent. Cumberland also had copper mines some centuries ago, and the Goldscope was England's most famous copper mine during the Tudor era, working a fabulously large force of men to get the very moderate amount of copper that was secured. During the first half of the Nineteenth century Cornwall and Devon were the world's largest producers of copper. The importance of England, as a source of copper supply, received a check from the development of the richer ores of Chile, and when Lake Superior, South Africa and Australia entered the field of production, the English output began to decline, until it now averages only about a million pounds yearly.

The copper ores of Cornwall and Devon, adjoining counties in the southwestern part of the island, are found in a clay-slate of the Devonian system having frequent bosses and veins of granite, with both slate and granite intruded by a quartz-porphyry. The veins are narrow, three feet being a liberal average, and are frequently capped with gossan, this capping being more common over the copper veins than above the veins carrying tin stuff. Veins of copper seem to favor the slates, while tin takes more kindly to the granite, but these observations hold true in a general way only, as there are many exceptions to the rule, while tin is frequent in copper mines, and copper is of common occurrence in the tin mines, and in places tin and copper alternate in occurrence. As a rule the richest portions of a mine are found where the veins have the sharpest dip. Native copper, while rarely found in quantities of commercial importance, is by no means uncommon, and is found in serpentine at the Lizard. One mass of native copper weighing three tons was secured from a mine near Mullion, Cornwall. The ores of copper are of many varieties, most of the more common sorts occurring, while many of the rarer copper minerals have been found, from time to time, in these two counties.

**FAROE ISLANDS.** Native copper, associated with mesotype, occurs disseminated in amygdaloid rock in these islands, but no attempt at mining has ever been made, so far as known.

**FINLAND.** Copper ore is found at several points in Finland, but the only active mines in the grand duchy are at Pitkaranta, where chalcopyrite in sahlite occurs in a granite country rock. These mines have been worked for many years and produce about one million pounds of refined copper annually.

**FRANCE.** The wealth of France is in her fertile soil, and not in her minerals. Copper ores are found at various points and a number of mines have been opened, but none of them ever proved either large or very profitable, and at present the production of copper from French mines is insignificant, having amounted to only 201 metric tons for the year 1900, the latest figures obtainable from the government bureau of mines. There are copper mines in the department of Var, Gard and Corse, also in Savoy and in the Basse-Pyrenees near the Spanish frontier. Argentiferous copper ore to the extent of 1,184 tons was exported to England in 1900 from the department of Ariege. In the same year 837 tons of iron-copper pyrites were exported to the same country, from the department of Corse, and 115 tons of copper ore were mined in the department of Gard.

**GERMANY.** The copper mines of Germany rank second in importance in Europe only to those of Spain and Portugal. The industry is one of considerable antiquity, and the history of the Mansfeld mines can readily be traced back to A. D. 1199, in which year the first copper was mined. The Mansfeld district, near Eisleben, in the Southern Hartz mountains, is much the most important in the empire. In this district the ore is found in beds of the Permian system, resting unconformably on crystallized strata of Paleozoic rocks. The eldest of the Permian rocks is a sandstone of several hundred feet in thickness, superimposed upon which is a second sandstone of little depth, upon which, in turn, rests the celebrated "kupferschiefer," or copper-bearing shale, a clayey slate averaging but two or three feet in thickness, and carrying a disseminated sulphide ore returning an average of about 2.5 per cent. metallic copper. The upper sandstone lying next below the kupferschiefer is also copper-bearing to some extent, and is worked at times. The area of the kupferschiefer is very great, probably nearly 200 square miles, and a number of square miles have been worked out and many miles worked over in the seven hundred years that the mines have been in operation. The Mansfeld district is notable for the possession of coal for fuel and limestone for fluxing, in the rocks above the copper-bearing strata, and ore, fuel and flux are sometimes mined from the same shaft.

There are also copper-bearing measures of lesser importance at Goslar, in Prussian Saxony; at Rammelsberg, in Nassau, and still less important ore bodies at several other points in the empire.

**HERZEGOVINA.** The industrial statistics of this semi-independent little country are usually included with those of Bosnia in the figures of the dual monarchy of Austria-Hungary, as Bosnia and Herzegovina are under the protection of Austria, since the congress of Berlin in 1878. The joint production of copper by Bosnia and Herzegovina reached 237 tons in 1901. Operations are carried on in a most primitive manner, at the few points where any copper mining is done.

**HUNGARY.** The kingdom of Hungary has about a dozen copper smelters, all small and none modern in design or practice. Copper is mined at a number of different points, the sulphide ores predominating, and the industry is one of great antiquity in this country, but has made comparatively little progress of late, the production remaining practically stationary. The principal mines are in the vicinity of Rezbanya and Dognacska, though even the largest mines are not big producers, and there are a number of small properties from which a few hundred tons of ore are extracted annually.

**IRELAND.** The copper production of Ireland is insignificant at present, averaging possibly 20 tons yearly, and is secured by cementation from the waters leaching from old mine openings. There are three copper districts in the island, these being the Wicklow, Waterford and Cork and Kerry fields. In the Avoca valley of Wicklow sulphide ores occur in clay slates, much as in Cornwall and Devon. The industry was once important and in 1799 the Conncree mines yielded 677 tons of refined copper, which was a big product for those days. The 1899 production was 17 tons, obtained by leaching and cementation.

In the vicinity of Knockmahon, in County Waterford, the ores are also sulphides in clay slates, and averaged about 10 per cent. copper when worked. In 1843 the output of finished copper was upwards of 900 tons. In the southern part of Cork and Kerry large mines were opened during the Eighteenth and early Nineteenth centuries, the Mountain and Keallonge mines each being more than a quarter mile in depth, while there were other considerable properties at Berehaven and Lackamore, and on Ross island. All these have been idle for some years.

**ITALY.** Copper was mined in Italy previous to the Christian era by the Romans, and before their day the metal had been extracted by the Etruscans. The industry has had its ebb and flow, but has never been entirely at a standstill, for more than two thousand years. There are a few mines with fairly modern equipments, but as a rule the properties are worked upon a somewhat narrow scale.

The principal copper districts of Italy are four in number, viz.: Volterrano, Grosseto, Liguria and the western Alpine region. The ores of the Volterrano district, mainly chalcopyrite, with a little chalcocite, are found in a red gabbro known locally as porfido rosso. This district has been the scene of copper mining operations from the earliest times of which authenticated records remain.

The Grosseto district is now producing considerable copper from ores occurring both as contact and fissure veins. The Val Castruccio, Bocchegiano, Montecatini and Capanne Vecchie are the principal mines of this district, and the principal mining center is Massa Maritima, the Massa Metallifera of Roman days.

The Ligurian mines lie near the coast of the Mediterranean, above Genoa. The copper ores are found in stratified azoic rocks, as contact veins lying between the diorite or serpentine and the metamorphic rocks, the gangue of the sulphide ores being quartzite.

In the Piedmont district mines were worked in Roman days, and traces of old workings are to be seen at many points. The ores occur in stratified archaic rocks, no fissure veins being found, and nickel and cobalt are frequently associated with the copper, the Calcante being a typical example of the copper-nickel mines of the district. A little native copper is found in some of the Italian mines. In 1900 there were 16 productive mines in the kingdom.

**NORWAY.** There are considerable deposits of copper ore in Norway, the principal district being near Trondhjem, where the sulphide ores lie in schists and slates of the lower Silurian system. Ores are also found in Telemarken in a granitic country rock, and copper ore is mined to a greater or less extent in the amts of Trondhjem, Stavanager, Nordland and Finmarken, the principal mines being in the Sulitjelma and Roros districts and in Stavanager and Tromsoe. A number of Norwegian copper mines lie to the northward of the Arctic circle. The production of copper from the mines of this kingdom is slowly increasing.

**PORTUGAL.** Much of what appears under the title of Spain applies to the copper deposits of Portugal as well, and to save needless repetition the reader is referred to the article on Spanish copper deposits in this chapter, for a general description of the cupriferous measures of the Sierra Morena, of which the mines of San Domingos and Grandola, in Portugal, form the western extension. The principal mining fields are the San Domingos, Grandola and Aljustral districts, with lesser properties developed in the Algarve and Aveiro districts. The San Domingos is much the most important mine of the kingdom.

Owing to the close propinquity of the Spanish and Portuguese copper districts, and the operation of mines in both kingdoms by the same English companies, the outputs of both countries are usually lumped in statistics of production. The Portuguese production in 1901 was equivalent to 9,933 metric tons.

**ROUMANIA.** There are copper deposits, apparently of importance, in this country. In the Carpathian Mountains chalcopyrite and carbonate ores are found at Valea Choboroasa, these assaying 7 per cent. cupric oxide, with a little gold. Samples of ore from Salishtea gave 18 to 32 per cent. cupric oxide and 100 grams gold per ton. Carbonate ores have been found in promising quantities in the district of Dobroudja, at the towns of Balabancea, Islam-Geafer, Carapelit and at Altan-Tepe near Tcheamourli.

**RUSSIA.** There are extensive copper-bearing measures in the empire of Russia, those of Siberia being separately treated in the chapter on Asiatic copper deposits. As a rule the copper is found in rocks of the Permian system, the name of which was taken from the heavy outcrops found in the government of Perm, where many of the principal Russian copper mines are located.

The principal mines of European Russia are in the governments of Perm, Elizabethpol, Orenburg, Kutais, Tiflis, Nijni Tagilsk and Viatka. Two of the three principal copper producing properties of the empire are in the government of Perm, and these make more than one-half of the Russian production. The Bogoslovski works turned out 72,961 poods of finished copper and the Rudianski works made 86,473 poods, in 1900. The Kargalinski works, in the government of Orenburg, made 18,849 poods in the same year. The governments of Perm and Orenburg are in the Ural Mountain region.

In the Caucasus region are the mines of the governments of Tiflis and Kutais. The largest producer is the Dzansulski, in the government of Kutais, with an output of about 14,000 poods. The Merisski works, in the same government, made 4,544 poods in 1900, and the Alverdski and Shamblurgski works in the government of Tiflis produced 4,490 poods in 1900. The production of refined copper by the mines of the entire Russian empire, including Siberia and Finland, amounted to 7,534 metric tons, in 1899, the latest year for which official figures are available.

There are a number of old mines in the empire, of little productive importance at present, such as the Miednoroudiansk, in the government of Nijni Tagilsk, famous for its massive malachite, a single mass weighing 330 tons having been taken from this mine in 1836. The Kiadebek, or Kadabenski mine, in the Elizabethpol district, is operated by German capital, and is one of the most important mines of the empire, though no figures of production, other than mere estimates, are available for present use.

There are about thirty smelting plants for copper operated in the empire, including those in Siberia. Most of these are small and antiquated, though there are a few that are fairly modern. Judging from the immense extent of the copper-bearing measures, and the good grades of ore secured in the better mines, there is a future ahead of the Russian copper industry, much brighter than might be inferred from the limited development secured in the centuries that have elapsed since copper was first mined and smelted.

**SCOTLAND.** There are deposits of chalcopyrite in Perthshire, Kirkcudbrightshire, and at several other points in Scotland, but no copper mining is done.

**SERVIA.** Copper mines have been operated, on a limited scale for many centuries in Servia. There are old mines and a few active properties at a number of points, but the principal copper producers are in the vicinity of Majdanpec. The production of refined copper from Servian mines was 270 metric tons in 1900.

**SPAIN.** The kingdom of Spain possesses great mineral wealth, and in the value of its copper and iron measures leads all the other countries of Europe. Copper ores are found in Huelva, Alicante, Almeria, Asturias, Badajos, Barcelona, Burgos, Caceres, Castellon, Coruña, Cuenca, Gerona, Granada, Guadalajara, Huesca, Jaen, Leon, Lerida, Logrono, Madrid, Malaga, Minorca, Navarra, Palencia, Santander, Segovia, Sevilla, Taragona, and Teruel, and in all of these copper mines have been opened. Mining is being done at present in a number of these provinces, but the preponderating production of the kingdom comes from the mines of Huelva. This district is in the Sierra Morena of the province of Huelva in southwestern Spain, and the cupriferous formation continues into the adjoining kingdom of Portugal. This district is said to be some 30 miles wide by 150 in length, extending from Aznalcollar in Sevilla to San Domingos in Portugal, but the limits of the demonstratedly profitable zone are much more circumscribed. The Sierra Morena, or Andevallo cupriferous belt as a whole, is divided into four zones. The eastern zone includes the Cerro Muriano and other mines near Sevilla, while the western zone is in Portugal, with the village of Grandola as an approximate center. The northern zone includes the principal mines of both Spain and Portugal, while the leading mines of the southern zone are the Tharsis, Castillo del Buitron, Lagunazo and Las Herrerias. All of these zones present the same general characteristics, having lenticular masses of ore that parallel the layers of slate and the strike of the veins in the porphyry. The ore bodies are of varying size, sometimes of immense dimensions, the largest reaching a length of nearly 4,000 feet and an extreme width of 500 feet. These lenses are usually found at the junction of slate and porphyry. The slates are of the Paleozoic group and probably of the lower Carboniferous system. Their strike is northwesterly, and dip to the north. These slates are of a yellowish tinge at surface, where weathered, but bluish at a little depth. The slates have been intruded by porphyry, syenite and diabase, the porphyries occurring in a succession of parallel lenses with the same strike as the slates. The ore bodies are also parallel with the slates and porphyries, and may be considered true contact veins.

The ore bodies, below the shallow alteration zone at surface, are formed of an intimate mixture of chalcopyrite and pyrite, giving a disseminated sulphide ore of copper averaging 3 to 4 per cent. metal, though considerable ore of higher grade is encountered. The ores are slightly argentiferous and auriferous, and under the highly perfected processes of extraction now employed, the values of the precious metals are quite closely extracted, and small as is their percentage this saving amounts in the aggregate to large sums, owing to the immense tonnage of ore treated annually. A strong tendency is noticed in the lower levels opened in these immense lenses toward decreased dimensions and lessened values.

References to the interesting metallurgical processes employed in the Hispano-Portuguese mines will be found in the chapter on metallurgy, and more detailed references to the geology of the various important mines will be found in the descriptions of the principal mines of Spain and Portugal.

The first copper mining in the Iberian peninsula was done, in all likelihood, by the Phœnicians, some 3,000 years ago, and was continued by the Carthaginians. The Romans succeeded to the dominion of the peninsula, and extensive traces of their work are yet to be found in the Sierra Morena.

Mine timbers, which in all likelihood were put in by Roman workmen nearly or quite two thousand years ago, are still in place, effectually protected from the gnawing tooth of time by the preservative action of the copper sulphate with which the mine waters are liberally charged. The modern era of Spanish copper production dates from 1860, when the Tharsis mine—the Tharsish of the ancients—was reopened. The Rio Tinto was reopened as recently as 1876.

**SWEDEN.** Copper has been mined in Sweden for more than 600 years, from the famous mines of Falun. The ore at this point is chalcopyrite occurring in connection with iron pyrites, and is found in lenses of considerable size. The Storra Kopparberg mine, near Falun, is the best-known property of the district, and furnishes much of the copper, some of the silver and most of the gold produced in the kingdom. Copper ores are found in the läns of Ostergotland, Malmohus, Orebro, Vestmanland and Kopparberg. There are mines in all of these districts, most of which are small producers or entirely idle. There are three smelters in Sweden, of which the most important is at Atvidaberg. In addition to the metal produced from direct smelting, a little copper is produced at Helsingborg by superphosphate works which extract the copper from the cupriferous iron pyrites residues, producing about 120 tons of cement copper annually. About 550 tons of blister copper is turned out from the smelters at Atvidaberg, Falun and Kafvelstorp, the copper production of the kingdom being insufficient to supply the domestic demand.

**TURKEY.** Extensive copper deposits exist at several points in the Balkans, on both the Bulgarian and Turkish sides of the mountains. The present copper production of Turkey is probably 3,000 to 4,000 metric tons yearly, of which amount the exports are about 2,500 tons, but these figures are estimates, except in the case of exports. Of exports of approximately 2,400 metric tons made in 1900, the mines and smelters of Arghana Maden sent about 1,400 tons, while about 1,000 tons came from Bakir Maden, near Diarbekir, Asiatic Turkey. The mines at Tokat were once considerable producers, but have fallen off latterly. Copper has been mined and smelted for some centuries near Kharput, and has been produced to a considerable extent by the mines of Kalabak, near Mount Ida, from time immemorial, having been ancient in the time of Strabo, who describes them. The ore at this point is chalcopyrite occurring in slates and limestones said to be of the Tertiary period.

**WALES.** The copper mines of Anglesea were worked by the Romans, and possibly by the Phœnicians before them. There were also considerable mines in Merionethshire, and up to about 1830 Wales was a considerable producer. At present the only copper production is a score or two tons produced yearly as cement copper from the water leaching out of the old Parys and Mona mines.

# CHAPTER XII.

## COPPER DEPOSITS OF AFRICA.

There are important developments in copper mining at several African points, and it is probable that the Dark Continent will become a much larger producer in the future than it ever has been in the past. The deposits and developments of this continent are treated alphabetically.

**ABYSSINIA.** The mineral wealth of Abyssinia is largely a matter of conjecture, but it is certain that copper exists at various points. The Negus Menelik, emperor of Abyssinia, has evidenced progressive tendencies since the Italian invasion of his country was repulsed and has encouraged foreign capital. It has been stated in press dispatches, published late in 1902, that mining and railroad concessions are being revoked, but the news has not been confirmed. Abyssinia is a mountainous country, lacking railroads or good wagon roads, and the development of copper mines is apt to await the securing of better transportation facilities.

**ALGERIA.** Chalcopyrite and antimonial gray copper ore (tetrahedrite) are the principal copper ores of Algeria. The gray copper found in Kabylia is somewhat argentiferous, and occurs in rocks of Jurassic age. The Aïn Barbar mine, in the department of Constantine, near the Tunisian frontier, has a rather remarkable lense of sulphide ore averaging 8 to 15 per cent. copper, absolutely isolated and enclosed in Ligurian schists. The copper is associated with galena and zinc blende. Along the Mediterranean coast, in the department of Constantine, there are a number of small veins, of no great depth, carrying sulphide ores, in a gangue of quartz. There are several mines of antimonial ores carrying more or less silver in the department of Alger, but none of them are worked at present.

**ANGOLA.** The existence of sulphide and carbonate ores, in considerable abundance, is reported from various points in Angola, but, so far as known, none of them have been opened, and no attempts at development are contemplated at present.

**ASHANTI.** The occurrence of native copper, apparently in dendritic forms, in the country several days' journey back from the Ivory Coast of Ashanti, is reported to me by Mr. John Nolan, of Sekondi, Ashanti, who is in charge of diamond drill explorations for gold, conducted by sundry English corporations.

**BASUTOLAND.** According to Sir Godfrey Lagden there are indications of copper, tin and iron in Basutoland.

**CAPE COLONY.** The copper production of Cope Colony comes exclusively from Namaqualand, on the west coast, the productive area lying in Little Namaqualand, about 90 miles from the Atlantic. All copper ore shipments are made through Port Nolloth, which ranks fourth in exports in this colony. There are two large companies operating in this district, and the first production was secured in 1852, since which time copper has been exported to the value of nearly $60,000,000.

The ore is chiefly chalcopyrite, returning an average of 17 to 19 per cent. in smelting, these figures making it evident that considerable care is exercised in selection. The country rock is granitic, and the ore occurs in lenses, often of great size. The largest mine is the Ookiep, which is partly exhausted. Little Namaqualand has apparently been a decadent district for some years, but recent explorations have shown promising deposits for future exploitation. It is now purposed building a new railroad, which should prove a considerable stimulus to the development of new mines.

**CONGO FREE STATE.** The existence of copper ore deposits, some of which are apparently of workable size and richness, has been known for years, but no mining worthy of the name has ever been done. The natives of the upper Congo dig a little iron and copper ore and smelt them with charcoal in pits, for the making of weapons and utensils. At Katanga there are several workable deposits, the ore occurring as lenses in schistose sandstones. At Mboko-Songo a few small mines have been opened in limestone. Ore has also been found in Yambingo, at Manyanga, and near the western shore of Lake Albert Nyanza.

**FRENCH CONGO.** Copper ore exists at several points in this colony and at least one mine is now in process of development, in the vicinity of Brazzaville.

**GERMAN EAST AFRICA.** The existence of copper in this protectorate has been reported, from time to time, but, so far as can be ascertained, no efforts have ever been made to develop regular mines on any of the deposits located.

**GERMAN SOUTHWEST AFRICA.** Copper ore has been found in this protectorate between the Swakab and Knisib rivers, and a mine is being developed at Windhoek by the Damaraland Copper Syndicate, Ltd.

**GERMAN WEST AFRICA.** It is reported to the German Colonial office that ores of copper, gold, silver and lead have been found in abundance at a spot about 400 miles inland from Walfisch Bay.

**GOLD COAST OF AFRICA.** The ores of a variety of valuable metals, including those of copper, have been found at various points in the interior of the Gold Coast of West Africa, but no attempt has been made at developing copper mines.

**MADAGASCAR.** Very little has been done as yet, either by the French government or private capital, for the development of the copper resources of the great African island of Madagascar, although the copper measures already known would seem to warrant exploitation, or, at least, careful government inspection by trained scientists. There are native mines, worked in a crude way by the Hovas, at Ambataofaugehana in the district of Ambositra and at Vohinana. In this district there are two mountain caps, between which are extensive mica-schists of several miles in length. The ore is principally malachite, averaging 10 to 45 per cent. copper, and has sometimes been found carrying higher percentages. These mines are apparently about worked out. Other native mines are reported from the Betafo country. In this district of Imerinarive in the Cercle de Tsiafahy native copper has been found. The metal has also been found in virgin form in the district of Vonizongo. The country about Lake Kinkony in the Cercle of Mahavavy has long been reported rich in copper. According to some rather indefinite reports traces of copper have been discovered recently in the province of Vohemar.

**MOROCCO.** Though only three hours from Europe, Morocco is almost as effectively closed to civilization as though it were in the center of the Dark Continent. The country is reported to be rich in copper, as well as other minerals, but the sciences of statistics, geology and mineralogy have yet to be discovered in Morocco. Copper ore is found not far from Tangier, and was being mined and smelted, circa 1860, near Tarudant, capital of the province of Sus. This seems the latest authentic information to be had upon the copper deposits and industry of this kingdom.

**NATAL.** Copper ores exist in this colony, but little has been done in the way of exploration and no mines have been developed. The value of the discoveries made is largely a matter of conjecture.

**NYASSALAND.** The ores of copper, nickel and zinc have been discovered in Portuguese Nyassaland, but no attempts at mining have yet been made in the case of the copper ores.

**RHODESIA.** Prospecting for copper has been in progress for several years, and while Rhodesia has not gotten to the productive stage, there are good indications of payable copper mines being secured in the Lomagundi, Umtali and Victoria districts, and development work is now in progress in all of these districts, while copper ores have also been found in the Melselter district. Several strong British corporations are now at work in different parts of the colony, and thorough tests of the value of Rhodesian copper measures are quite certain to be secured.

Much the most important and most extensive development work is under way in the Victoria district, where copper has been found, apparently in large quantities, near the Kufeke river, a short distance north of the Victoria Falls of the Zambesi river. These falls are of immense height and volume, and are to be harnessed by the South Africa Chartered Company, which has engaged the services of Sir Douglass Fox and Sir Charles Metcalf as expert electrical engineers for devising the works, which, in all likelihood, will be modeled quite closely along the lines of the immense electrical power installation at Niagara Falls. The plans of the company are drawn upon a most ambitious scale, and include the generation of sufficient power to operate not only the mines, but also a railroad line from the falls to the mines, and possibly also a railroad to the coal fields about 150 miles distant.

**SENEGAL.** Copper ores occur in the vicinity of the Senegal river, but details are lacking.

**SUDAN.** The only producing copper mine in the Anglo-Egyptian Sudan is the Hofret-el-Nahas, in southwest Kordofan, and this, owing to lack of adequate transportation, is worked solely for local consumption, mining and smelting being upon a primitive scale. Prospecting is now being done in various parts of the Sudan, but no copper has been found as yet, though there is thought to be copper in the Suakin district.

**TRANSVAAL.** Copper ore was discovered in this colony near Rustenberg, just previous to the outbreak of the Anglo-Boer war. The discovery is said to possess sufficient merit to warrant further attention.

**UGANDA PROTECTORATE.** Copper is vaguely reported from Uganda, somewhere between Lake Victoria Nyanza and the Nile, but precise information as to these discoveries seems lacking.

**ZULULAND.** Sulphide and silicate ores of copper have been discovered near the Insuzi and Umhlatuzi rivers, in the Nkandhla district of Zululand. Apparently no attempts have been made to prove the possible value of these ore bodies, which are some distance from transportation lines.

# CHAPTER XIII.

## COPPER DEPOSITS OF ASIA.

As in the preceding chapters, the copper deposits of Asia are treated alphabetically, by countries.

**AFGHANISTAN.** The northern part of this country is said by travelers and natives to be rich in copper, Owing to the peculiar political position of the country, which is a buffer state between British and Russian possessions, industrial progress meets with discouraging obstacles. The development of modern copper mines demands railroads, and it is not probable that Great Britain would look with favoring eyes on railroad construction, as such lines would afford an advantage to Russia in case the latter country desired to invade India. The Russians, however, are pushing a transcontinental railway in the direction of northern Afghanistan, and this may lead, when completed, to the development of mineral resources now latent.

**ANNAM.** There are deposits of copper ore in the province of Quang-Nam, Annam, but detailed information as to the character and extent of the ores has not been secured for the present issue of this work.

**ARABIA.** There are deposits of copper ore near the shores of the Red Sea in Arabia Petrea, and a number of old mines are found on the slopes of Mt. Sinai. These mines, which yield turquoises as well as ore, were evidently never rich in metal. It is probable that they were the first copper mines ever opened, and the date of the first mining is probably as remote as 5000 B. C. The mines were the property of various nations, from time to time, and were the cause of various wars between the races coveting them, but were held mainly by the Egyptians. It is probable that after being worked for more than three thousand years they were finally abandoned before Moses led the children of Israel out of Egypt. The scepter of Pepi I, a Pharaoh of the Sixth dynasty, now preserved in the British Museum, is made of pure copper, and probably came from the mines of Mt. Sinai. The ore is chyrsocolla in porphyry, and the ruined furnaces and slag piles found near the old adits, still open, show that the ore was smelted at the mines. Analyses of the slags do not show the use of fluxes in the reduction of the ores.

**CHINA.** Copper is of quite general occurrence in China, but, owing to the lack of authentic records accessible to investigators from countries of better industrial development, details regarding many of the provinces are lacking. Copper mines have been worked for many centuries under the most primitive methods of mining and smelting. The production of the empire is estimated at five million pounds annually, all of which is consumed in China.

Among the more important properties are those of the province of Yun-Nan, in southern China, where sulphide veins occur in limestone and sandstone strata near intrusive igneous rocks. The ore is both auriferous and argentiferous. Native metal is also found sparingly, in grains and small masses. The principal production of the empire is from this province, estimated at about 3,000,000 pounds yearly, of which upwards of 2,000,000 pounds are exported to other provinces. Kwei-Chau, also in southern China, produces a limited amount of copper, from ore bodies resembling those of Yun-Nan. There are also a few mines operated in primitive manner, with small production, at San-Kia-Tschang in the province of Ho-Nan, and a little mining is done in the province of Sze-Chuan.

The most modern copper mines and smelters are in Manchuria, and a new and well-equipped reduction plant has recently been completed at Kaya. With the industrial awakening of China, certain to come during the first quarter of the present century, the mineral resources of this vast empire will receive adequate attention, and while the immediate future holds out no promise of great mines, these will come in time.

**COCHIN-CHINA.** The existence of copper deposits, apparently of importance, is known in Cochin-China, but no mines are worked.

**INDIA.** Before the beginning of authenitc history copper was mined and smelted in India, the production being secured along the simplest possible lines of digging and reduction. India was a considerable producer of the metal during the middle ages, and up to the beginning of the Nineteenth century, after which the output fell off slowly. During the Eighteenth century India shipped large quantities of copper to Europe, but the current was reversed later. The last active copper mining upon a considerable scale was done at Baragunda, from 1887 to 1891, but the chalcopyrite ore returned only 1 to 3 per cent. copper, and this was insufficient to permit a profit. A few tons of copper ore are still mined every year, and there are ore measures that will doubtless receive attention at some future time.

**JAPAN.** According to carefully-kept Japanese annals, copper was discovered about the beginning of the Eighth century. Mining and smelting were of the most primitive sort, the ore being reduced in clay pits, with charcoal for fuel. The first exports, other than to China, were made in the Seventeenth century, when Holland had a monopoly of Japanese trade, and copper was exported annually to the extent of 700 to 1,200 tons for many years.

After the opening of Japanese ports by Commodore Perry, in 1854, the Japanese were quick to realize the advantages of foreign technics and training. All branches of industry have been revolutionized in the past fifty years, and in no trade has greater progress been made than in the mining and smelting of copper. Modern hoists and pumps, air compressors and power-drills, high explosives and other latest aids to mining have been applied, and Japan now has several strictly modern smelters. It must not be inferred that all Japanese copper mines are well equipped and operated in full accordance with the latest practice, for many of the mines are but little improved from the methods in vogue two hundred years ago, but the bulk of the production is secured under advantageous conditions, with excellent machinery, and under the direction of highly-trained engineers and metallurgists. Japanese mining men visit all of the important copper-producing fields of the world, and their practice ranks deservedly high.

Japanese copper ores are almost exclusively sulphides, and there are mines in nearly every province, though half of the 300 copper mines of the empire are idle, and there are but fifty mines or so that make fifty tons or more of refined metal yearly, while the bulk of the Japanese production comes from two groups of mines, the Ashio and the Besshi. Most of the copper ores carry silver, usually in quantities of commercial importance, while several mines have gold-copper ores, the gold values running as high as five ounces per ton in the selected ores of one mine. A little native copper is also found, as well as oxidized ores in limited quantities.

According to the latest available official figures, of date Jan. 1, 1900, the area covered by Japanese copper mines is 54,618,045 tsubo, a tsubo equalling 36 square feet, and mines covering 29,114,697 tsubo, or a little more than half the total area, were in operation. In addition, there were several mines of compound metals, from which a limited amount of copper was secured as a by-product.

The production of refined copper increased from 33,180,250 kin in 1894 to 40,459,709 kin in 1899, a kin being nearly equal to 1⅓ pounds avordupois.

The most prominent figures in the Japanese copper industry are Messrs. Ichibei Furukawa of Tokyo, owner of the Ashio group, and Kichizayemon Sumitomo of Osaka, proprietor of the Besshi mines. Both have done much to modernize copper production in Japan, and to them their country owes a debt of gratitude for the breadth of view that led them, though gentlemen of the old school, to adopt the most modern improvements in their works, thus setting an example of great value as well as providing one of the most valuable exports of the empire.

**KOREA.** Copper ores are said to abound in this hermit kingdom, but details are scanty. A start has been made at gold mining with modern machinery and methods, and something will doubtless be done later with some of the more promising deposits of copper.

**PERSIA.** This country has long been known to be rich in copper, and there are mines, so called, in nearly every province, many of them very old. The methods of mining and smelting are of the crudest, and the production is necessarily small, being merely sufficient for the limited demands of the country itself. Until there are better railroad communications and foreign capital can be enlisted in such enterprises but little will be heard from the copper mines of Persia.

**SIBERIA.** Copper deposits have been located at a number of points in Siberia, and a little mining has been done in several districts. The only mining of any importance now in progress is at Semipalitinsk, where the Pavovski mines and smelters turn out upwards of a million pounds of refined copper annually. The government of Semipalitinsk is rich in mineral resources, including coal and iron, and a large number of copper mining claims were located in 1900 and 1901, on few of which anything of importance has been done. The Akmolinsk district has received some attention from prospectors, and upwards of 100 copper claims have been registered in the Karkaralinsk district. The value of these districts, judged by surface indications, is said to be considerable, but actual mining will be required to determine the true status of the new fields.

**TONQUIN.** There are copper mines, operated by natives on very crude principles, in the provinces of Sontay, Langson and Laokay, and the ores are said to be of good grade, although the production is necessarily small, owing to lack of modern machinery and methods.

**TURKESTAN.** There is one small mine, the Karankulski, in the Tashkent district of Turkestan, and there are other unworked ore bodies, some of which are apparently worthy of exploitation.

# CHAPTER XIV.

## COPPER DEPOSITS OF AUSTRALIA AND OCEANICA.

In this division of the earth the more important copper deposits and mines are developed in the commonwealth of Australasia, though there are beds of copper ore in New Caledonia and elsewhere that give promise of making good mines. The political divisions of Australia, Tasmania and New Zealand are first treated, after which references are made to the other islands in alphabetical order.

**AUSTRALIA.** The first copper shipment from this island continent was made in 1843, from South Australia, thus antendating the first production of Lake Superior mines by one year. The ores of Australian mines are principally sulphides, though rich carbonates are found at the Blinman mine and elsewhere, while native copper occurs at many points. The copper production of the commonwealth of Australia comes mainly from Tasmania, New South Wales and South Australia following, with 18 or 20 per cent. of the total product each, and Western Australia and Queensland bringing up the rear. More detailed references to the various states of the commonwealth are given under the titles of each, in the following brief articles.

**NEW SOUTH WALES.** The Great Cobar mine was opened in 1869, and was the first real copper mine of the state, though attempts at copper mining were made as early as 1847. A considerable number of copper mines, mostly shallow and with small development, have been opened at various points, from time to time. The Cobar district, in the western part of the state, is much the most important, and the Great Cobar mine produces the bulk of the copper output. The country rock of this district is mainly slates of the Silurian system, with few eruptive rocks—a rather unusual home for copper. There is also a cupriferous district in the central part of the state, where eruptive rocks predominate, and there are a number of scattering mines along the coast.

**QUEENSLAND.** This state was at one time a regular copper producer in a small way, but the industry fell upon evil times when the price of copper went down in 1889, after which copper production and development were at a low ebb until about 1898, when there was a great revival. The older copper fields were at Peak Downs, Cloncurry and Mt. Perry. At Peak Downs native copper was mined from amygdaloid trap, under conditions greatly resembling those governing in the Lake Superior copper district. Lack of transportation facilities caused the suspension of work. The Australian

Copper Company was once a considerable producer from the Cloncurry district, but high transportation charges caused the abandonment of that field also.

In the Mt. Perry district there is considerable activity, several strong mining companies being now at work. The Queensland railroad affords good transport, and there are smelters at the mines. The country rock is granite, and the veins are mineralized only for a portion of their width, the rich zones of mineralization rarely averaging a foot in width. Ore values have disappeared with depth in some cases, but in one instance remain unimpaired to a depth of 800 feet. The ores are highly silicious, but it is purposed using the auriferous and argentiferous gossan for a flux, which should kill two birds with one stone.

The Chillagoe district of the Herberton field has ores in carboniferous limestone, the geological conditions being comparable with those of certain Arizona districts. The existence of ore deposits without regular walls, forming a stockwerk, is a typical feature of this district. Development has been hampered by lack of adequate transportation facilities, but this will be remedied by the completion of the Chillagoe railroad, an ambitious undertaking designed to aid in the development of the mineral wealth of a large part of Queensland hitherto inaccessible. A big water power at Barron Falls is available for use at the Chillagoe mines.

There is also considerable activity in the Mt. Garnet district, though something of a chill has been caused by the drop in the price of copper in 1901. A number of small mines have been opened in the Stanthorpe district. These are said to be of promise. Undeveloped copper deposits are also known to exist in the neighborhood of Rockhampton and Gladstone, at Ravenswood, near Cardwell and to the west of Townsville, also, at other points on the eastern watershed.

**SOUTH AUSTRALIA.** The Kapunda mine was first opened in 1842, a decade before the discovery of gold, and in 1845 the Burra Burra began production. Since that time South Australia has been a regular though not altogether steady producer of copper, and it seems probable that the present annual output of five to six thousand tons is far less than this state is capable of producing. The Moonta was opened in 1863 and later consolidated with the Wallaroo, 10 miles distant. This consolidated property is now the chief producer of South Australia. The first smelter was built at Port Adelaide in 1851, and the second at Wallaroo ten years later.

On the Yorke Peninsula, where the Wallaroo and Moonta mines are opened, the country rock is porphyry, and the ores are principally sulphides, with oxidized ores, including a considerable percentage of atacamite, in the upper parts. A barren zone of 50 to 125 feet lies between the oxidized ores and the unaltered sulphides, though the veins continue regularly, but are filled with gangue rock only.

In the Kapunda district, 50 miles north of Adelaide, where the first mining was done 60 years ago, the ores are oxides and carbonates, with some native copper. In the Burra Burra district, about 100 miles northeast of Adelaide, the country rock is limestone and shale, with very irregular deposits of rich altered ores, more regularity in vein formation being noted at considerable depth. Many mines have been opened in South Australia during the past 60 years, but only a few of them have been developed in more than the most rudimentary manner.

**VICTORIA.** The existence of copper deposits at various points in Victoria has long been a matter of common knowledge, but for some reason no serious mining has been done. The most notable field is in the Beechworth district, where outcroppings of copper ore have been found at a number of points in an area of about fifty square miles.

**WESTERN AUSTRALIA.** This state is noted for its large and profitable gold mines, but copper mining is not in a very advanced stage, although the first mine was opened as long ago as 1855. The total production to date is slightly under 15,000 tons, and the current rate of production is less than 1,000 tons per year. The principal development is in the Mt. Malcolm district, where the ore is matted in water-jacket furnaces at the mines. In other districts the ore is hand-dressed for shipment to distant smelters, and of course only the richer altered ores can pay for hand-work and high carriage charges.

Other principal cupriferous districts of Western Australia are the West Pilbarra, Murchison, Northampton, Mt. Margaret, Phillips River, Ashburton and Champion Bay. In the West Pilbarra district the country rock is a schistose slate, the copper occurring in a compact intrusive rock of igneous origin. The ore, chiefly carbonates and oxides of high grade, is secured by quarrying. In the Northampton district, the cupriferous belt is said to reach from the Irwin river on the south to the Murchison river on the north, and to carry rich copper carbonates, as well as lead ores. The Ashburton is a new district, in which a number of leases have been granted, but development work is so slight that little seems known beyond the assured existence of copper ore. The Phillips River district carries silicious gold ores, and ferruginous copper ores, the latter apparently in considerable quantities. The ores are mainly malachite and chalcocite, and are of high value, average assays running 31.48 per cent. copper, 2.16 oz. silver, and 0.15 oz. gold per ton. Taken all in all, it may be said that while Western Australia has been but scratched for copper, the results indicate the existence of several districts of distinctly above the average promise. The drawbacks are scant water supply and lack of railroads, but these can be overcome by a judicious combination of capital, time and skill.

**TASMANIA.** The copper mining industry of this island has had a rapid growth. The Mt. Lyell mine begun production in 1896, and a large number of new mines were projected in the immediate vicinity. The promoters of these properties displayed a most lamentable paucity of imagination, or else a strong desire to profit by the name of the first successful mine of the district, and as a consequence practically all of the actual and projected copper mines of Tasmania are Lyells of some degree, at least in name.

There is a little native copper in Tasmania, and a limited amount of chalcocite, but the deposits are mainly low-grade chalcopyrite, with a little bornite. The ore bodies occur as mixed iron-copper sulphides, in enormous bodies, in conglomerate and quartzite, the country rock being a micaceous schist. The principal mines are the Mt. Lyell and North Mt. Lyell, two properties that should be one, as each is the natural complement of the other, and both could be best worked as one, the Mt. Lyell ore being low in copper but rich in sulphur, while the North Mt. Lyell ores are of high grade but illy adapted for smelting without a flux of just the sort found in the chalcopyrite of the Mt. Lyell. The Mt. Lyell Blocks is notable for its present attempt to develope a native copper mine, the prospects of which are said to be good.

The Tasmanian copper fields are among the most important opened within the two past decades and give promise of large production in the future. So far development is confined almost exclusively to the Mt. Lyell district, but a little exploring is being done in the Mt. Jukes and Darwin fields. Tasmanian production (exports only) was 11,221 tons of ore and 9,981 tons of blister copper running better than 99 per cent. in the year 1901.

**NEW ZEALAND.** Copper mines were opened and worked on Great Barrier Island and on Kawau Island, New Zealand, circa 1865, but the mines were closed when the price of copper fell. There has recently been some talk of reopening the Kawau Island mine. A mine was also opened at Nelson, circa 1880, on a sulphide ore vein, by Melbourne people. This mine had a smelter, and it has recently been proposed to reopen the property. Ore has also been found at Omaunu, Whangaro county. A little copper ore is dug and exported every year, the production amounting to but 12 tons of ore in 1900.

**BORNEO.** The existence of copper, gold, coal and other minerals has been noted in the northern part of the island of Borneo.

**JAVA.** This island is the source of a small annual supply of copper, obtained under the most unique conditions. In the Gunong Kendeng district there are springs containing iodides in solution, and from these thermal waters crude iodide of copper is secured by evaporation, the production amounting to 2,346 kilograms in 1899. It is probable that deposits of copper ore exist in the interior of the island, but definite data is lacking on this point.

**NEW CALEDONIA.** Copper has been mined to some extent in the northern part of this island, the ore occurring as chalcopyrite in lenticular masses in talcose and chloritic schists, these being said to contain an average of 16 per cent. copper. Silver is found in association with the copper in most cases, and New Caledonia is, next to Canada, the most important source of nickel supply at the present time.

**SOLOMON ISLANDS.** Copper ore has been found in the British Protectorate of the Solomon Islands, but details are lacking.

**PHILIPPINES.** Copper has been mined and smelted in a crude way in these islands since the Eighteenth century. In a typical native reduction plant the ore, after being hand-mined, is cobbed to medium size, then broken to small lumps on anvils, after which it is reduced to still finer size by passing through trains of rolls, usually of iron, but sometimes of stone. The ore is then smelted in crude furnaces and brought to metallic form by successive manipulations. Naturally, the production is small, and is all taken for domestic uses. There are no figures of output available. There are copper and gold mines at Mancayan and Suyoc, province of Lepanto, Island of Luzon, also at other points on this island, the copper ores of Luzon being auriferous as a rule. There are also deposits of copper ore, from which a little metal is extracted occasionally, in the islands of Benguet, Negros, Panay and Mindanao, and also, it is believed, in the little-known island of Sulu.

# CHAPTER XV.

## COPPER MINES OF THE WORLD.

This chapter, containing much more than half of the entire work, is devoted to detailed descriptions of the copper mines of the world. As it would require not less than fifty pages in fine type for a mere alphabetical index of the various mines and mining companies listed in this chapter, it has been thought best, both for economy in space and to facilitate reference, to insert the mine descriptions in alphabetical order, regardless of geographical location, thus rendering this chapter self-indexing. While the plan has some disadvantages, it seems, upon the whole, to offer conveniences that could not be secured by any other arrangement.

A large number of small idle mines and moribund mining companies listed in the 1902 edition are omitted from the present volume, notwithstanding which there are nearly four times as many mines and mining companies described in the present chapter as were listed in all chapters of the preceding year's edition.

**AAMDAL COPPER MINES SYNDICATE, LTD. NORWAY.**

Present corporation succeeded Aamdals Kobbervaerks Aktieselskab in 1899. Mines at Mo, Bratsbergamt, Norway. No returns secured from company. Latest reported production, 240 tons in 1895.

**ABERDEEN COPPER CO. NEW MEXICO.**

Office: 44 New St., New York. Mine office: Lordsburg, Grant Co., N. M. Mine is a producer, employing about 40 men. Capitalization, $1,000,000, shares $25 par, non-assessable. R. Horton Batchelor, treasurer and general manager; E. M. McCormick, superintendent; Edw. Brady, mill superintendent; H. L. Bowen, mining captain; Lands, 52 unpatented claims, area 1,145 acres, in Virginia district of Grant Co., showing 10 fissure veins, of which 7 are developed; average width of veins 5′. Ores, sulphide, returning 7% copper, 0.1 oz. gold and 10 oz. silver per ton. Eight shafts, aggregating 1,600′; 1,500′ underground openings; 30,000 tons ore blocked out for stoping. Plant includes air compressor, drills, steam hoist, pumps, etc.; has 50-ton concentrator equipped with crusher, rolls, stamp, jigs and tables. Company has paid dividends of $32,175. New work planned for 1903 includes sinking three shafts to depth of 1,000′, erection of 250-ton concentrator and installation of 50-ton smelter.

**ACARI COPPER MINING SYNDICATE, LTD. PERU.**

An English company, address probably London, that did some mining work in the Acari district, province of Camana, Peru. Mines not working at present.

**ADAMS COPPER CO.** **WYOMING.**

In vicinity of Saratoga Carbon Co., Wyo. W. S. Adams, superintendent. Was working small force at close of 1902.

**ADAMS COPPER & REFINING CO.** **COLORADO.**

Office: 513 Cooper Blk., Denver, Colo. Capitalization, $800,000, shares $1 par. Property, four mining claims in Larimer Co., Colorado. Deepest shaft, 100′. Ore carries copper and gold values. No returns secured.

**ADDIE COPPER MINING COMPANY.**

Letter to former address, 206 Mining Exchange, Denver, Colo., returned unclaimed.

**ADELAIDE STAR MINING CO.** **NEVADA.**

At Golconda, Humboldt Co., Nevada. Otto Stallman, superintendent. Opened by shaft and tunnel. Has steam power, concentrator and small smelter. Said to be employing a fair force, but no returns secured.

**ADIRONDACK MINE.** **MONTANA.**

At Butte, Silver Bow Co., Mont. Jas. Murray, owner; operated under lease by Conroy & Co. Main shaft about 500′; steam power equipment.

**ADMIRAL MINE.** **WYOMING.**

A property somewhere in the vicinity of Encampment, Carbon Co., Wyo., regarding which details are lacking.

**ADMIRAL GOLD & COPPER MINING CO.** **NEW MEXICO.**

Office: Sterling, Kansas. Mine office, Tusas, Rio Arriba Co., N. M. Employs 8 men. Organized 1900, under laws of New Mexico, with capitalization $500,000, shares $1 par, non-assessable. C. A. Cooper, Lyons, Kansas, president; W. M. Bisbee, secretary; Robt. Findley, treasurer. Has 5 unpatented claims, area 120 acres, in Bromide district of Rio Arriba county, showing 3 fissure veins, averaging 10′ in width, with sulphide ore, and 3 shafts, deepest 130′. New work contemplated for 1903 includes 300′ of development and installation of steam plant and power drills.

**ADVENTURE CONSOLIDATED COPPER CO.** **MICHIGAN.**

Office: 45 Broadway, New York; mine office: Greenland, Ontonagon county, Mich. Employs about 500 men and is a regular producer. Organized 1898, under Michigan laws, with capitalization $2,500,000, in 100,000 shares, par value $25 each, $16 per share paid in. Transfer agent, Old Colony Trust Co., Boston; registrar, American Loan & Trust Co., Boston. Chas. J. Devereaux, president; Wm. R. Todd, secretary and treasurer; W. A. O. Paul, assistant secretary and treasurer; C. J. Devereaux, Isaac H. Meserve, Henry A. Wyman, John Barker, Wm. R. Todd, directors. At the mine Thos. Dennis succeeds P. R. Robert as superintendent, and Richard Cocking is mining captain, vice, Thos. Trevarrow. S. A. Prince is clerk and Henry Keys mill superintendent.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,400,000.00 |
| Entire amount invested in real estate | 250,000.00 |
| Amount of personal estate | 441,401.53 |

| | |
|---|---|
| Amount of unsecured or floating debt.............. | 38,571.70 |
| Amount due the corporation...................... | 106,831.54 |
| Production of copper, 1901, in pounds........... | 29,361 |

Items of income and expenditure from organization to close of the year 1901 were as follows:

| | |
|---|---|
| Total income from all sources...................... | $1,425,070.47 |
| (Income from production of copper............ | 10,786.55 |
| (Income from capital stock and assessments ... | 1,400,000.00 |
| (Interest.............................. | 14,283.92 |

On the organization of the company $5 per share was paid in by the subscribers, of which amount of $500,000 the sum of $250,000 was paid for lands and an equal amount placed in the treasury for development. An assessment of $3 per share was levied in June, 1900; $6 was called for in June, 1901, and $2 was called in October, 1902, making a total of $1,600,000 paid in on capital stock account to Jan. 1, 1903.

The lands of the company include the old Adventure and Hilton mine tracts, in one body, to the eastward, and the Knowlton mine, in a second tract lying a mile southwest of the main area. These three old mines have an area of 1,696.22 acres on the mineral belt, in addition to which there is a millsite on Lake Superior. The mineral lands are located in Sections 35 and 36, Town 51 North, Range 38 West, and in Sections 1 and 2 of Town 50 North, Range 39 West. The Toltec and a fragment of the Belt property lie on the north; the Aztec on the east; Toltec and Mass on the south, and the Mass on the west of the main tract. The Knowlton tract has the Mass Consolidated to the north and east; the Flint Steel to the south, and the Michigan to the west. The village of Greenland lies on the northwestern corner of the principal tract of the Adventure, about two miles by wagon road from the main workings, and the village of Maple Grove, controlled by the company, is near the mine. The Ridge mine of the Mass Company lies between the old Adventure and Knowlton mines of the Adventure company.

The Adventure mine was opened in 1850, along a line of old pits showing prehistoric mining operations. The largest production, in 1857, was 116 tons, 1,941 lbs. After the closing of the mine by its owners the old workings were tributed for years, with good results. The mine was always notably rich in silver. The Hilton, once known as the Ohio, was opened in a primitive manner in 1863, on the Mass lode, but was never equipped or worked vigorously. The Knowlton was opened in 1853. The three old mines in the present consolidation made a total output of 974 tons, 1,173 lbs. refined copper previous to their consolidation.

Work was begun by the present company Nov. 1, 1898, and has been continued uninterruptedly, resulting in the opening of a large mine, fitted with a surface plant of the most modern design and great capacity. There is a series of seven parallel copper-bearing beds in a cross-section of about 1,200 and these, coupled with the existence of Adventure Bluff, quite a high hill, have caused the opening of the Adventure by adits as well as shafts, this method permitting the mining of a large amount of ground before any rock need be hoisted through shafts. The "South Range," or "Evergreen Belt," of Ontonagon county, on which the Adventure is opened, comprises a belt of bedded traps, amygdaloids and conglomerates, and on the Adventure lands seven of these amygdaloids carry copper in considerable quantities. These lodes from north to south, are as follows:

(1.) Knowlton. This is the bed on which the shafts of the mine are opened; runs from 4′ to 28′ wide with an average width of about ten feet. The rock is rich in epidote, chlorite, prehnite and the minerals commonly found associated with these in the Keweenawan series. A considerable proportion of the product is found as heavy copper.

(2.) Merchants. Underlies the Knowlton amygdaloid at a distance of 20′ to 65′; is a stamp-lode, but has produced masses up to 500 pounds weight; has been opened by crosscuts and considerable drifting done upon it, but has not come up to expectations formed when first opened by present company. Will probably average about 10′ in width. Was first opened in 1856.

(3.) Mass. This is a continuation of the same lode found at the Ridge, but is a poor sort of bed where opened on the old Adventure. It carries no large masses of copper and has but little stamp rock. In the Hilton, to the east, the Mass lode shows good rock, as it also does in the Knowlton, to the southwest, and will probably be valuable to the Adventure company at other points than at the old Adventure. Lode averages about 10′ wide and lies about 100′ south of the Merchants.

(4.) North Butler. This bed lies nearly 100′ south of the Mass, and carries some copper, but has never been tested sufficiently to prove its real worth.

(5.) Butler; sometimes called the Champion. Is the widest and most vigorous amygdaloid on the property. It ranges from 12′ to 50′ in width, with an average of nearly 20′, and lies nearly 200′ south of the North Butler; ranges in value from very rich to absolutely valueless; carries masses to a considerable extent, but in proportion to its great width will give but a small amount of stamp rock, though fine stopes are occasionally opened. Being so wide, it can be mined cheaply; always has been noted for its richness in silver. This amygdaloid apparently has a felsite base, and is chemically and mineralogically quite different from the parallel strata on either side. A large amount of opening work has been done on this lode, and it is from the Knowlton and Butler beds that the owners look to get their copper mainly.

(6.) Ogima. Lies about 100′ south of the Butler, and has been but little opened on the Adventure. Developments show good stamp rock.

(7.) Evergreen. Lies about 250′ south of the footwall of the Ogima bed and averages probably 10′ width. Has produced considerable copper at adjoining mines; was first cut by the Adventure in August, 1902, showing 10′ width, with about 4′ well mineralized.

The cupriferous lodes of the Evergreen belt are notoriously bunchy, being exceedingly rich in spots, and entirely worthless at other points. It is obvious that an average of values can be reached only by very extensive openings, and these the Adventure has, assuring a fair test to the district—something it has never been given before. The strike of the parallel lodes of the Adventure is N. 73° E. on the main tract, where operations are now in progress, and the shafts are sunk at an angle of 45°. There are four shafts and four tunnels. The shafts are all on the Knowlton lode, and numbered from west to east. No. 1 is a 3-compartment shaft, 7x18′ inside of timbers. Surface equipment at No. 1 includes a steel boiler house 38x59′, with three 500-h. p. Burt boilers; steel engine house 59x59′, having a new Allis-Chalmers double-cone duplex direct-acting hoist with 24x60″ cylinders, capable of raising a 12-ton load from the depth of 5,000′ on an incline of 45° at a speed of 2,000′ per minute. The compressor house, of steel, 38x65′, is at this point and has a 60-drill Rand-Corliss air compressor of high efficiency, steam coming from three 500-h. p. Burt boilers. The shafthouse and rockhouse at No. 1 are separate buildings, 200′ apart.

No. 2 shaft is 6x12′ inside of timbers, with two compartments. The shafthouse is connected with No. 3 rockhouse by a 600′ trestle with gravity tram, also with a railroad siding by a 300′ gravity tram trestle.

No. 3 shaft is 7x18′ inside of timbers with three compartments and combination steel shaft-rockhouse 42x84′ on the ground and 116′ high. The engine-house is of wood, 59x59′, with a duplicate of the hoist at No. 1.

No. 4 is a development shaft with temporary equipment 2,500′ east of No. 3, and has reached no great depth.

Water for boilers is taken from a stream dammed near No. 1 shaft. The mine has a complete electric light and power plant, and a system of electric haulage was installed August, 1902, in the Butler tunnel, which is nearly a half mile in length, and is proving very satisfactory. All of the principal mine buildings are sheathed with steel and painted. Twenty-five new double houses were built in 1902, and the mine location is an exceptionally handsome one, the big mine structures and thoroughly neat and comfortable houses of employes being set off by natural beauties of topography and forest rarely excelled. The location is fully protected by water mains, fed by a reservoir on Adventure Bluff.

The Copper Range main line crosses the Adventure tract, and a spur reaches the mine. The Mineral Range railroad also crosses Adventure lands but does not reach the mine. Rock is taken to the mills by the Copper Range.

The stampmill is at Edgemere, on Lake Superior, 1½ miles west of the Baltic mill. Work was begun in the spring of 1901, and the first head started Sept. 22, 1902. The mill was built and equipped complete by the Allis-Chalmers company. The mill proper is 135x217′, of steel, on stone foundations. The boiler house is 69x72′, and the pump house 38x72′. Equipment includes three Allis-Chalmers heads fitted with Parnall-Krause mortars, having 11 / 16″ openings in discharge screens, with two horizontal revolving screens having 5 / 16″ openings for each head. The stamp pistons are automatically rotated, equalizing the wear on shoes. From the revolving screens of the heads the crushed rock goes to the separator jigs, 24 for each head, or 72 to the mill, thence to the 36 finisher jigs. There are round slime tables, also three Overstrom and three Wilfley concentrators, and two Huntington regrinding mills for the raggings. The rock bins of the mill have a storage capacity of 4,500 tons — three days' supply. Coal is delivered from trestles to the boiler-rooms by gravity, through chutes. The pump is a 16,000,000-gallon Riedler, drawing its supply from Lake Superior through a tunnel extending 1,200′ under the bed of the lake. Miscellaneous improvements at the millsite include office, smithy, machine shop, hotel, dwellings, etc. There is 8′ to 12′ of clear water off-shore, permitting the landing of cargoes from scows in good weather.

The Adventure mill went into full commission so late in 1902 that no definite estimates of results are possible, but the management of the company expresses satisfaction with the mill returns.

**ADVENTURERA MINING CO.** **MEXICO.**

At Sabinal, Chihuahua, Mex. Produces silver, lead and copper. Opened by shafts; has steam power; employs about 125 men.

**AETNA MINE.** **ARIZONA.**

Near Williams, Coconino Co., Ariz. Lombard, Goode & Co., owners. Has steam power and small smelter; was said to be employing 40 men, at last accounts.

**AETNA MINE.** **MICHIGAN.**

An idle mine in Keweenaw county, Michigan, that produced 70 tons, 881 lbs. copper, 1863–1873. Company reincorporated in 1899 for term of 30 years. Affairs in hands of W. K. Prudden, Lansing, Mich.

**AETNA MINING CO.** **COLORADO.**

Said to be a copper-silver property, developed by tunnel, at Bonanza, Saguache Co., Colo. Letter to that address returned, October, 1902.

**AETNA MINING CO.** **WYOMING.**

At Riverside, Carbon Co., Wyo. Roger Daniels, superintendent. Was developing with small force late in 1902.

**AFORTUNADA COPPER MINES, LTD.** **SPAIN.**

Offices: 10, Norfolk st., London, W. C., Eng. Mine office: Figuera, Gerona, Spain. Capitalized at £75,000. Hon. J. A. de Grey, chairman. Enjoys perpetual mining rights to about 690,000 square metres leased from Spanish government at nominal rental and 2% royalty.

**AFTON MINING & SMELTING CO.** **MONTANA.**

Office: Helena, Mont. Idle. Organized 1897, under laws of Washington, with capitalization $60,000, shares $500 par, $70 paid in. T. J. Davies, president; T. F. Henegan, vice-president; F. M. Dudley, secretary; S. R. Oldaker, treasurer. Lands, three claims, area 44 acres, in Colorado Gulch, Lewis & Clarke Co., Montana, showing three fissure veins, one with average width of 75′ carrying sulphide ore and small quantities of oxides and carbonates, having estimated average value of 2%. Development, four shallow shafts and 730′ tunnel.

**AGASSIZ MINING CO. ARIZONA.**

Office: 92 State st., Boston, Mass. Organized 1900. Has 17 claims, area about 340 acres, also 40 acres of placer gold property on the Gila river, near Ray, Ariz. Capitalization, $1,250,000, shares $1 par.

**AGORDO MINE. ITALY.**

A small producer, in the province of Venetia, Italy, regarding which particulars are lacking.

**COMPAGNIE FRANCAISE DES MINES DE CUIVRE D'AGUAS TENIDAS. SPAIN.**

Offices: Rue de Chateaudun, 39 bis, Paris, France. Supposed to be developing Spanish copper mines, but no returns secured respecting operations or location of property.

**AGUASCALIENTES COPPER CO. MEXICO.**

At Tepezala, Aguascalientes, Mex. Albert Doerr, superintendent. Owns and operates La Merced and other mines, producing copper-silver ores. Uses animal power and employs a considerable force of men.

**AHMEEK MINING CO. MICHIGAN.**

Office: 199 Washington st., Boston, Mass. Property, 920 acres, lying immediately west of the Mohawk, in Keweenaw Co., Mich. Two shafts were sunk on the Kearsarge conglomerate but abandoned many years ago. Exploratory work was resumed in the fall of 1902, and a vertical shaft was down 75′ on Dec. 1. Crosscuts will be sent to intercept the Kearsarge amygdaloid, of which this property undoubtedly has the underlay. There seems no reason why the Ahmeek should not bear the same relation to the Mohawk that the Tamarack does to the Calumet & Hecla.

**COMPAGNIE DES MINES D'AIN-BARBAR. ALGERIA.**

Offices: Rue Dulong, 39, Paris, France. Mine, in department of Constantine, Algeria, closed 1899, but company is considering resumption. Has several veins of sulphide copper ores, associated with lead and zinc sulphides, carrying 8% to 15% copper. Production in 1899 was about 50 tons only.

**AK-SAR-BEN COPPER CO. WYOMING.**

Near Encampment, Carbon Co., Wyo. A. H. Crow, superintendent. Was developing with small force at last accounts.

**COMPAGNIE FRANCAISE DES MINES DE CUIVRE D'AKHTALA. RUSSIA.**

Offices: Rue Tronchet, 27, Paris, France. Mines, in the Russian Caucasus. No returns secured.

**AKTIEBOLAGET ATVIDABERGS KOPPERVERK. SWEDEN.**

Office and mine: Atvidaberg, Ostergothland, Sweden. Organized 1900, under laws of Sweden, with capitalization 900,000 kroner, par 1,000 kroner, fully paid. Baron Th. Adelswald, president and general manager; Axel Nygren, superintendent; C. A. Rudelius, smelter superintendent. Ores èxculsively sulphide and slightly argentiferous. Has 8 shafts, 300′ to 1,400′ deep, and about 4,000′ of underground openings. Water power is utilized to generate electric energy for operation of mine and works. Smelter at Bersbo, 9 kilometres from mine, connected therewith by railroad. Has crusher works, 3 roasting furnaces, 3 reverberatory furnaces and settling tanks for precipitating metallic copper from solutions. Ores average 2% copper. Output for 1901 was 158,000 kilograms cement copper; 60,959 kgs. refined copper, and 186 kgs. silver. Estimated copper production for 1902 is 163,000 pounds. Output has been small for past few years, owing to lack of good ore. A new shaft has been sunk in promising ground and production should increase.

**ALABASTER CAVE GROUP. CALIFORNIA.**

Owned by Holmes Lime Co., San Francisco, Cal.; bonded to Anderson & Hoagland. Property, 180 acres, unpatented. Vein traceable 6 miles, with strong gossan outcroppings. Ore said to average 4% copper, with pay-streak of 3′ to 8′ in vein of 12′ to 20′, between limestone and slate.

**ALADDIN & CAPE NOME MINES. MONTANA.**

At Clinton, Missoula Co., Mont. J. P. Porter, manager. Were opening shafts with small force at last accounts.

**ALAMO COPPER CO. ARIZONA.**

Supposed to have copper claims near Ajo, Ariz., but neither claims nor office located.

**ALASKA COPPER CO. ALASKA.**

Near Valdes, Alaska. Has been stated in newspapers that H. O. Havemeyer, of New York, is president. No returns secured.

**ALASKA COPPER CO. ALASKA.**

Office: 430 Globe Blk., Seattle, Wash. Mine office: Coppermount, Alaska. Employs 25 men. Organized 1900, under laws of New Jersey, with capitalization $5,000,000, shares $25 par. Henry W. Mellen, president and general manager; Jacob A. Canter, vice-president; C. F. Reynolds, superintendent; Frank T. Hunter, purchasing agent. Directors are preceding officers, John F. Crowley, Jas. D. Hoge and R. H. McCutcheon; R. H. Mellen, smelter superintendent; Frank B. Seeley, mining engineer. Lands, 36 claims, 18 patented, area 540 acres, also 60-acre millsite and 20-acre smelter site, on Prince of Wales Island, Alaska, showing 3 contact veins, 2 of which are stated by company to average 24′ width by 1,600′ length and 60′ width by 1,400′ length, giving assays 6% to 7% copper, $5 to $7 gold and 3 oz. silver per ton. Ores are oxide and carbonate, chalcocite and chalcopyrite, slightly nickeliferous. Shaft, 150′; 3 tunnels of 200′, 430′ and 500′. Estimated amount of ore blocked out for stoping, 30,000 tons. Water-power plant of 140-h. p., also sawmill, air compressors, tram-line, etc. Company has wharves on tidewater. For 1903, underground development will be continued and it is hoped that one furnace will be in operation by August. Estimated production for 1902, 100,000 lbs. Company will ship no more ore, awaiting completion of its own smelter. Property is well handled and well regarded.

**ALASKA DEVELOPMENT SYNDICATE. ALASKA.**

Address: care of Sam Silverman, Spokane, Wash. Company has copper claims near Copper Harbor, Prince of Wales Island, Alaska. Property located one to two miles from tidewater and said to be of considerable promise.

**ALASKA MINING CO. UTAH.**

Near Silver City, Juab Co., Utah. E. L. Talbot, superintendent at last accounts. No returns secured.

**ALBERNI GOLD & COPPER CO., LTD., BRITISH COLUMBIA.**

Owns the Thistle group, on Douglass Mountain, Alberni Canal, B. C. Assays of chalcopyrite give up to 1 oz. gold per ton.

**ALDA COPPER CO., LTD. SPAIN.**

Offices: 20, Bucklersbury, London, England. A new corporation, opening copper properties in the district of Cabrales, Asturias, Spain. Has shipped 200 tons of 30% gray copper ore from the mine Don Fulano, which shows a 6′ vein that apparently also traverses the adjoining claim, El Clavel, owned by same company.

**ALDA COPPER MINES., LTD. SPAIN.**

Offices: 11, Queen Victoria st., London, E. C., Eng. Mines, Cabrales district, Asturias, Spain. Is developing copper and coal mines. Capital, nominal, £130,000. H. Higgins, chairman; W. T. Rushton, secretary. A 30-ton smelter was in course of erection at last accounts. Company became engaged in litigation with its chairman in June, 1902.

**SOCIETE MINIERE D'ALDEIRE. SPAIN.**

Offices given as Mouscron, Belgium, but letter to that address returned October, 1902. Mines at Aldeire, Guadix, Granada, Spain.

**ALGOL MINE. CALIFORNIA.**

At Spenceville, Nevada County, California. Originally opened, circa 1865; reopened 1899. Vein 50′ to 60′ wide, with highly mineralized portion 2′ to 10′ wide. Two shafts, 120′ deep each. Native copper and native gold occur. Ores are cuprite, malachite and azurite. Ten carloads shipped to smelter gave average returns 20% copper. Horse and steam power used.

**ALGOMA COMMERCIAL CO., LTD. ONTARIO.**

Office: Sault Ste. Marie, Ont. Lands, Sudbury, Algoma, Ont. A. B. Willmott, superintendent of explorations. Owns the Elsie nickel-copper mine, 4 miles from Sudbury. C. M. Boss, superintendent. Company understood to be planning a 100-ton smelter. No returns secured.

**ALGONQUIN COPPER CO. WYOMING.**

Office: 177 Broadway, New York. Henry H. Adams, president; Jas. E. Coe, treasurer; W. H. Dowe, secretary. Organized under laws of Wyoming, with capitalization $1,000,000, to develop copper prospects in that state. No returns secured.

**ALICANTE GROUP. COLORADO.**

Includes Alicante, John Reed and Maud Hope mines, at Wortman, Lake Co., Colo. G. C. Wortman, manager. Ores carry gold, silver, lead, copper and zinc; has steam power and 35-ton concentrator.

**ALICE GOLD MINING CO. WASHINGTON.**

Office: 204 Empire State Bldg., Spokane, Wash. Mine office: Blue Creek, Stevens Co., Wash. Organized 1896, under laws of Washington, with capitalization $150,000, shares 10 cents par, non-assessable. J. F. Nylander, president; J. B. Benway, vice-president; W. M. Higley, secretary and treasurer. Directors are preceding officers and E. F. Timberman, Gust Holmes and Geo. Pope. Benj. F. Parker, general manager. Mining lands, 11 unpatented claims, area 225 acres, in the Chewelah district of Stevens Co., showing 4 fissure veins and lenses, latter of considerable dimensions, carrying sulphide ores and said to show good values in gold and copper. Opened by 2 shafts of 200′ each, and 2 tunnels. Company contemplates erecting a concentrator in 1903.

**MINA DE ALJUSTREL. PORTUGAL**

At Aljustrel, Portugal. Owned by a Belgian company. Ores, chalcopyrite and iron pyrites, running 1% to 7% copper. A regular producer.

**ALLEGHENY MINING CO. NEW JERSEY.**

Organized 1901, to work old copper mines in Pahaquarry township, near Delaware Water Gap, Warren Co., N. J. No returns secured.

**ALLENDE HERMANOS. SPAIN.**

At Elizondo, Navarra, Spain. Don Pedro Allende, manager. Are exploiting copper deposits.

**ALLESANDRO COPPER MINING CO. NEW MEXICO.**

Near Redrock, Grant Co., N. M. Lucius P. Deming, manager. At last accounts had 18″ vein at depth of 150′, assaying 40% copper, with gold and silver values.

**ALLOUEZ MINING CO. MICHIGAN.**

Office: 60 State St., Boston, Mass. Mine office; Allouez, Mich. Organized 1859, under Michigan laws; capitalization, $2,500,000, in 100,000 shares, par $25 and $19.16 paid in. New issue of stock, 20,000 shares, was divided pro rata among shareholders of record June 1, 1901. Last assessment, $3 per share, levied October, 1901. Annual meeting, second Tuesday in March. H. F. Fay, president; W. B. Mosman, secretary; Geo. D. Endicott, treasurer; Jas. Chynoweth, superintendent; H. F. Fay, Godfrey Morse, John C. Watson, Stephen R. Dow, Walter L. Frost, H. A. Tucker, W. B. Mosman, Geo. G. Endicott and Jas. Chynoweth, directors.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,850,097.00 |
| Entire amount invested in real estate | 23,303.57 |
| Amount of personal estate | 166,440.83 |

No debts outstanding.

Lands consist of 520-acre tract, on which mine is located; 120 acres bought of St. Mary's Canal Mineral Land Co., in 1901, giving considerable addition to underlay of Kearsarge lode owned by the Allouez; also sundry undeveloped lands to the northward, mostly on the mineral belt.

The mine was opened in 1859, on the Allouez lode, a wide conglomerate underlying the greenstone that is such a noticeable rock stratum in Keweenaw county. Mining was not begun in earnest until 1869, and was stopped in

1877 with the treasury exhausted. The mine was then leased to Watson & Walls, who made money from it, after paying a royalty of 12½% on gross production. In 1880 the company resumed control, to quit once more, financially exhausted, in 1885. Watson & Walls took the mine again and once more did well; the company resumed work on its own account for the third time, and again lost money and quit work in 1892. Property has been idle some years, except for exploratory and development work 1898–1900, when a shaft was sunk 1,200′ on the Osceola lode, and nearly 4,000′ of openings secured thereon. Old conglomerate workings were unwatered January–July, 1902, and exploratory work resumed.

The Allouez conglomerate is fully 30′ wide in many places, having a strike of N. 39° E., and dip of 38°. Lode averages 0.7% to 1% copper, and is very refractory under the stamps. There are 3 shafts on the conglomerate, deepest about 1,700′.

Total production of mine, 13,025 tons, 1,528 lbs. refined copper. The mill is on Hill's Creek and has 3 stamps, one of which was leased to the Wolverine until completion of that company's new mill in fall of 1902.

**ALMA MINING CO. MEXICO.**

Mine office: Carbo, Sonora, Mexico. A. Graves, manager. Is developing claims carrying values in copper, gold and silver, by means of tunnels, and is working about 50 men.

**ALMADO & TERITO CONS. MINING CO. MEXICO.**

Mines at Alamos, Sonora, Mexico. Don Clemente Ybarra, manager. Values mainly gold and silver, with copper as by-product; opened by tunnels and equipped with a 30-stamp mill; steam power; about 125 men employed; also has small smelter.

**ALMERIA QUICKSILVER & COPPER CO., LTD. SPAIN.**

Offices: 17, Royal Exchange Sq., Glasgow, Scotland. W. D. Gillies, chairman; W. G. Millar, secretary. Capital, nominal, £45,000, in 150,000 shares, par 6s. Property, 1,100 acres, carrying quicksilver and copper, near Berja, Almeria, Spain.

**ALTENS KOBBERGRUBER. NORWAY.**

At Kaafjord, Finmarken, Norway. Is the northernmost copper mine of the world, being situated a few miles from the North Cape, in 70° north latitude. Owned by Consul Nils Persson, of Helsingborg, Sweden. Property working. Mine opened 1847. Otto Witt, general manager; P. W. George, mining engineer; E. Walseth, chemist; R. Rusten and Gustaf Swensson, mining captains. Lands, 200 claims, all patented, with area about 500 acres, also a 2-acre millsite and 2,000 acres miscellaneous lands, in the Altens district of Finmarken, Norway, showing about 30 fissure veins of copper and iron pyrites, 12 of which are more or less developed, these averaging 10′ in width by 3,000′ in length, with unknown depth, and carrying sulphide ores of rather low grade. Underground openings, about 12,000′. Mine is 300 miles from a railroad but only 300 feet from the sea. Equipment includes hoists, air and diamond drills, electric light, etc., actuated by Pelton wheel taking power from a waterfall of 1,000′. Mine has a new concentrator of 100 tons daily capacity. Company will continue development and prospecting work during 1903.

**ALVARADO MINE.** **MEXICO.**

At Promontorios, Sonora, Mexico. Don Clemente Ybarra, owner; Jesus M. Quijado, manager. Opened by shafts and tunnel; steam power; has 35-stamp mill; employs about 50 men. Products are copper, silver and lead.

**ALVERDSKI & SHAMBLURGSKI WORKS.** **RUSSIA.**

A. A. Broli, owner, Tiflis, Russia. Mines are in the Caucasus, government of Tiflis, Russia. Output of refined copper in 1899 was 4,490 poods, these being latest figures obtainable.

**AMADOR COPPER-GOLD MINING & MILLING CO.** **MONTANA.**

Offices: 507-172 Washington st., Chicago, Ill., and Wallace, Idaho. Mine office, Iron Mountain, Missoula Co., Mont. Maj. W. W. Woods, president; Jas. R. Sovereign, vice-president; John B. Taylor, treasurer; D. E. MacKinnon, secretary and manager. Property, 7 quartz claims and 1 placer claim, area 160 acres, carrying gold, copper and silver ores. Has air compressor, hoists, engines, pumps, etc., operated by water power, with auxiliary steam plant for emergencies. Organized 1899, under laws of Idaho, with capitalization $2,000,000, shares $1 par. Annual meetings, first Monday in January. Has 160′ shaft and about 1,000′ of underground openings. Has sawmill with daily capacity 20,000′. Property considered promising.

**AMALGAMATED COPPER CO.** **MONTANA.**

Office: 52 Broadway, New York. Mine office: Butte, Silver Bow Co., Mont. Organized April 27, 1899, under laws of New Jersey, with capitalization $75,000,000, which was increased in 1901 to $155,000,000, shares $100 par. Henry H. Rogers, president; Wm. G. Rockefeller, secretary and treasurer. Directors are Henry H. Rogers, Wm. G. Rockefeller, Albert C. Burrage, Wm. Rockefeller, Fred P. Olcott, Jas. Stillman, Anson R. Flower and Robert Bacon. National City Bank, New York, transfer agent. Annual meeting, first Monday in June.

The Amalgamated is not a mining company, as it owns no mines, but is a securities-holding corporation, its assets consisting of stock in sundry subsidiary companies. The following-named copper mining companies are owned outright by the Amalgamated, with the exception of the few founders' shares required to be in the names of directors: Washoe Copper Co., of Butte; Colorado Smelting & Mining Co., of Butte; Big Blackfoot Milling Co., of Bonner, Mont., and Diamond Coal & Coke Co., of Diamondville, Wyo. The Amalgamated also owns controlling interests in the stock of the following-named companies: Boston & Montana Cons. Mining Co.; Parrot Silver & Copper Co.; Butte & Boston Cons. Mining Co., and Anaconda Copper Mining Co., all of Butte, Mont. There is a large independent interest in the Anaconda, the Amalgamated owning probably about a 75% stock interest. The Amalgamated also owns the Hennesy Mercantile Co., operating large department stores at Butte and Anaconda, Mont., and, through the Anaconda Co., controls the Butte, Anaconda & Pacific R. R. The Amalgamated also owns a controlling interest in the United Metals Selling Co., and is credited by rumor with having a greater or less interest in the Santa Rita Copper Co., and other copper mining companies, regarding which no information is given out by the officials.

The reports given shareholders by the Amalgamated are very incomplete, and to all practical intents the company is managed as a close corporation, although it has thousands of shareholders.

The company began the payment of regular quarterly dividends of 1¼% on its organization in 1899; these regular dividends were supplemented by extra dividends of ½% quarterly until October, 1901, when the extra dividends were dropped. The quarterly dividend was reduced to 1% in January, 1902, and to ½% in May, 1902, making present dividend returns at the rate of 2% per annum on par value.

The generally understood purpose of the formation of the Amalgamated Copper Co. was to secure control of the copper industry of at least the United States and possibly of the globe, through the acquisition of the leading mines. It has been found impossible to carry through this program, and while the Amalgamated Copper Co. remains the largest single interest in the copper trade, it is by no means the dominant factor in the copper industry of the world, or even of the United States. It is well known that the Amalgamated maintained an artificially high level of prices during nearly the entire year of 1901, and this policy was followed by results disastrous to the Amalgamated and to all other copper producing interests. While the Amalgamated is a very important factor in the copper trade, it is by no means possible for the company to permanently control the price or production of the metal, and it is impossible to see how the company will be able to secure control of the American copper industry, although it has the services of men of great financial strength and ability. It is questionable whether the secretive policy of the company operates to the best interests of the shareholders, but inasmuch as a vast majority of the shareholders are interested speculatively rather than for investment, it does not seem that any particular amount of sympathy should be wasted upon them for the failure of the Amalgamated Copper Co. to earn the 8% dividends that were so freely predicted at the time of the company's organization.

**AMALGAMATED GOLD & COPPER CO. ARIZONA.**

Office: 66 Broadway, New York. Mine postoffice, Huron, Yavapai Co., Ariz. Organized under laws of Arizona, with capitalization $2,000,000, shares $1 par. A. J. Brockett, president; Geo. F. Jacoby, vice-president; Frederick F. Lacey, secretary; Chas. L. Andrews, treasurer. Directors are preceding officers and Andrew L. Bush, Irving H. Griswold and Alfred S. Amer. Annual meeting, third Tuesday in January. Property was promoted by Douglass, Lacey & Co., of New York. Company has ignored all requests for detailed information.

**AMERICA-BRITANNIA MINING CO. WASHINGTON.**

Prospecting near Baring, King Co., Washington, with C. Campbell superintendent, at last accounts.

**AMERICAN CONSOLIDATED COPPER CO. NEW MEXICO.**

Office: 44 E. Broad st., Columbus, Ohio. Mine office: Santa Fe, N. M. Employs about 50 men. Organized 1901, under laws of New Mexico, with capitalization $5,000,000, shares $1 par, non-assessable. Adelbert R. Gibson, president and general manager; D. A. Walker, vice-president and treasurer; Wm. Z. McDonald, secretary. Directors are preceding officers, Walter S. Douglas and J. A. Jones. W. B. Randall, superintendent. Lands, 32 claims, 4 patented, area 646 acres, in Santa Fe, Lincoln, Socorro and Grant counties, N. M. Properties show 8 fissure veins, of which 3 are being developed, these ranging from 4' to 70' in width, with an extreme length, as opened, of 4,100', giving estimated average values of 12% copper, $14 gold and 5½ oz. silver per ton. Ores, principally oxide and sulphide, with limited amount of carbonate. Has 11 shafts from 40' to 100' deep, with 3,000', of underground openings and about 50,000 tons of ore blocked out for stoping. Equipment includes steam hoists, crushers, concentrating machinery, pumps and engines. Concentrator has daily capacity of 50 tons. Mine is 2 miles from the Santa Fe and Southern Pacific railroads. Company contemplates development by sinking, drifting and stoping in 1903; is also giving consideration to new plant, but has not yet decided on process to be used; will also consider erection of new mill and smelter in 1903. Production for 1902 not given. Dividends paid quarterly, giving annual returns of 4½% on par value of stock, which has cost holders 20 to 60 cents per share.

**AMERICAN COPPER CO. WYOMING.**

Office: Williamsport, Pa. Property, in Douglas Creek district of Albany Co., Wyo., in vicinity of Rambler mine. No returns secured.

**AMERICAN COPPER MINING CO.**

Office: 4 Campau Bldg., Detroit, Mich. John Baker, president and general manager. Location of property unknown and no returns secured in response to repeated requests.

**AMERICAN COPPER MINING CO. NEW JERSEY.**

Office: 20 Broad st., New York. Mine office: Somerville, Somerset Co., N. J. Employs 15 to 30 men. Organized 1883, under laws of New York, with capitalization $500,000, shares $1 par, non-assessable. Josiah C. Reiff, president; W. S. Chapman, secretary; C. H. Burke, treasurer; Josiah Bond, general manager; John T. Downey, mining captain. Total area of mineral lands about 900 acres, mill site 50 acres, other lands about 100 acres, in Bridgewater Township, Somerset Co., N. J. Ore deposits are in blanket veins with average thickness of 2' and length of 3½ miles. Estimated minimum average of ore, 2% to 2½% copper, with small gold and silver values. Vein lies between trap and shale; upper portion shows carbonate and oxide ores; lower part gives native copper, occurring in chunks weighing up to 5 or 6 lbs. Formation and character of vein bear a considerable resemblance to the Keweenawan rocks of Lake Superior. Mine has adit or slope at dip of 10°, 1,252' long, from which 34 drifts, aggregating 2,000', have been run. Has steam equipment, Rand air compressor and drills, Lidgerwood hoists and tramway and necessary mine buildings. Concentrator, of 50 tons daily capacity, has

Allis mill, crusher, drier, two sets of rolls, screens and two Wilfley tables. Product is sold as concentrates to nearby smelters. For 1903 adit will be continued, this having shown improvement at depth, in native copper values.

**AMERICAN COPPER MINING & EXTRACTION CO.**

Office: Denver, Colo. Company owns Gardner leaching process, by which it is claimed that copper values can be leached from low-grade ores in an hour or so. Cannot be learned that process is yet in practical use.

**AMERICAN GOLD & COPPER CO.** **ARIZONA.**

Office: 401 Henne Blk., Los Angeles, Cal. Mine office: Wickenburg, Yavapai Co., Ariz. Property shows good copper-gold values. Was enlarging mill to 10 stamps at close of year, and has pumping plant with capacity of 3,000 gallons per minute. Capitalized at $1,000,000, shares $1 par, nonassessable. Area of lands, about 100 acres. Ore body opened on Fitzhugh Lee claims. Property and management well spoken of, but company ignores requests for returns.

**AMERICAN GOLD & COPPER MINING CO.** **WYOMING.**

Office: 79 Dearborn st., Chicago, Ill. Mine office: Laramie, Wyo. A. L. Stone, president; F. J. Wyatt, secretary; Louis Miller, manager. Has 14 claims, about 30 miles from Laramie.

**AMY C. MINE.** **COLORADO.**

At Idaho Springs, Clear Creek Co., Colo. John Owen, owner; Geo. Riley, superintendent; Has gold-silver-lead-copper ores; equipped with steam plant; worked 30 men at last accounts.

**AMYGDALOID MINE.** **MICHIGAN.**

In Keweenaw county, Mich.; owned by J. F. Carey, Escanaba, Mich., and E. L. Wright, Hancock, Mich. Idle since 1874; total production, 770 tons, 180 lbs. fine copper. Area, 2,240 acres. Six shafts and seven levels opened.

**ANACONDA COPPER MINING CO.** **MONTANA.**

Office: 52 Broadway, New York, N. Y. Mine office: Butte, Silver Bow Co., Mont. This is the largest copper producer of the world, and employs, directly and indirectly, about 5,000 men, under normal circumstances. Organized June 18, 1895, under laws of Montana, with capitalization of $30,000,000, shares $25 par. National City Bank of New York, transfer agent. Wm. Scallon, president; Henry H. Rogers, vice-president; Wm. G. Rockefeller, treasurer; W. H. Dudley, secretary; John Gillies, superintendent; F. I. Carns, acting superintendent; D. W. Brunton, consulting engineer; Geo. D. Case, smelter superintendent; C. H. Repath, chief constructing engineer; R. G. Collins, assistant constructing engineer. Directors are W. L. Bull, A. C. Burrage, H. H. Rogers, Wm. G. Rockefeller, E. C. Bogert and Wm. Scallon. Annual meeting in May. Stock is listed on the New York, Boston and London stock exchanges. Dividend coupons payable in England by the London Joint Stock Exchange Bank, Ltd., with warrants to bearer issued in denominations of 5, 20 and 50 shares.

Operations for the three preceding fiscal years ending June 1 are compared as follows:

| | 1900. | 1901. | 1902. |
|---|---|---|---|
| Gross yield per ton | $ 13.18 | $ 14.20 | $ 10.66 |
| Cost of mining per ton | 4.38 | 3.97 | 3.80 |
| Total mining cost | 6,228,655.00 | 5,069,071.00 | 3,742,312.00 |
| Cost transportation per ton. | .21 | .15 | .15 |
| Total cost of transportation. | 300,031.00 | 191,534.00 | 147,743.00 |
| Cost reduction per ton | 3.77 | 4.14 | 3.32 |
| Total cost reduction | 5,345,145.00 | 5,288,720.00 | 3,267,182.00 |
| Paid for labor | 5,878,851.00 | 5,572,392.00 | 3,860,789.00 |
| Paid for machinery | 5,703,949.00 | 4,785,399.00 | 3,148,705.00 |
| Cost of marketing | 1,481,780.00 | 2,007,415.00 | 2,052,105.00 |
| Gross proceeds | 18,730,131.00 | 18,128,558.00 | 10,498,953.00 |
| Recapitulation. | | | |
| Cost of mining | 6,228,655.00 | 5,069,071.00 | 3,742,312.00 |
| Freight on ore | 300,031.00 | 191,534.00 | 147,743.00 |
| Cost of reduction | 5,345,145.00 | 5,288,720.00 | 3,267,182.00 |
| Selling and marketing | 1,481,780.00 | 2,007,415.00 | 2,052,105.00 |
| Total expenditures | 13,355,611.00 | 12,556,740.00 | 9,209,342.00 |
| Net proceeds | 5,374,520.00 | 5,571,818.00 | 1,289,611.00 |
| Tons of ore treated | 1,421,500.00 | 1,276,890.00 | 984,958.00 |

The Anaconda was opened, circa 1880, by J. B. Haggin, the late Marcus Daly and Senator Hearst, as a silver mine. At slight depth the percentage of silver decreased and was replaced by high-grade copper ores, principally chalcocite and bornite.

The copper property of the Anaconda is located at Butte, Mont., and includes the following mines: Anaconda, Never Sweat, St. Lawrence, High Ore, Green Mountain, Diamond, Bell, Modoc, Wake-up-Jim and others.

Of the various mines of the company, the Anaconda proper employs 600 to 1,000 men. The three-compartment main shaft is down to about 2,000′ and mine is timbered with 10x10″ square sets. The mine has good ventilation and about 30 exits, having underground connection on the west with the Never Sweat, on the south with the Bell and on the east with the St. Lawrence.

The St. Lawrence mine employs about 700 men when fully worked. Fire has been burning in this mine since 1890 and despite every preventive measure that can be taken is still unextinguished. The water from this and other portions of the mine yields up the greater part of its copper values by leaching over scrap iron. A certain amount of concentration is secured underground in concrete sumps. The water originally carries 9 to 13 pounds of copper per ton, and on reaching surface carries 2 to 4 pounds.

The High Ore employs normally 200 to 300 men.

The main shaft of the Diamond is about one-half mile in depth and this property employs some 300 men.

The Green Mountain works about 200 men. The Bell employs 400 to 500 men when fully worked. The Mountain Consolidated employs 500 to

600 men. The Buffalo employs a comparatively small force. The Modoc is a very low-grade proposition, but has millions of tons of ore running 1% to 1½% copper, which may be made valuable at some future time by a leaching process. The Never Sweat employs about 500 men, and the principal shaft is more than 2,000′ deep.

The city of Butte takes its name from a prominent hill near by, this being a cone-shaped butte of rhyolite. The country rock is basic and is known as the Butte granite, this being the rock-wall of the fissure veins carrying copper and silver ores. There is also an intrusive acid rock, called the Bluebird granite. A quartz porphyry is the third rock of the series, in point of age, after which came the formation of fissures, the gangue rock being quartzite with decomposed country rock. A later eruption of rhyolite threw up the big butte to the west of the town. The richer ores of copper, found in the upper levels of the mines, include chalcocite, bornite, etc., these occasionally occurring below the water level. The oxides and carbonates frequently found near surface in mines of copper ore are not frequent in the Butte camp, the nature of the granitic country rock being unfavorable to the occurrence of such ores, which are most common in limestone formations. Like the veins in all other known mining fields, the ores of the Butte district grow leaner with depth, but the veins are of great persistence and strength at the greatest depths yet reached, and afford disseminated ores running 3% to 6% copper, in such vast quantities that an estimate would be the merest guess work.

The figures of recent years show a steady decline in the percentage of copper secured from rock smelted, due partly to the lessening values at greater depths and partly to improvements in equipment and practice that render it possible to smelt lower-grade ores at a profit. The mine still has many stopes of high-grade ore, though its percentage can never again become as high as in the past. The average of ore produced and treated by the Anaconda is between 3% and 5% at the present time. The mine has been pretty thoroughly worked out to a depth of about a quarter mile, although the openings are of such great extent that what would be immense ore bodies for smaller properties remain unstoped in the upper levels.

In addition to its developed lands the Anaconda company has large tracts of timber lands and sundry mining claims that, while not recognized as within the limits of the Butte camp at present, may become valuable in the future.

'A new system of drainage is nearing completion, the various mines being unwatered through the High Ore shaft, nearly a half mile in depth. This has powerful pumps, three of which are located on the 1,000′ level, 2 on the 1,600′ level and 2 on the 2,300′ level. The water of the various mines forked from this shaft will go to a big precipitating plant in the gulch back of Meaderville. The pumping capacity of this plant is equal to raising 4,000 gallons of water per minute from a depth of one-half mile.

Very extensive use is made of electric power. A generating plant is located at Canyon Ferry, 70 miles distant, and the current is wired to the mine, having a primary voltage of 50,000, which is reduced to 2,000 at the transformer station, just outside of Butte. The power is distributed to the various shafts and buildings from a main station at the Never Sweat. The principal dynamo at the station is of 800 h. p., being the largest in the world, this driving a large duplex air compressor. A three-phase dynamo driven by the Canyon City current furnishes the motive power for a direct current generator that actuates an extensive underground haulage plant just installed to replace compressed air. A considerable number of electric lights are also used underground, being employed wherever possible. A large number of minor motors at the various buildings of the surface plant are driven electrically, using a 440-volt current.

Although the title to the big reduction plant stands in the name of the Washoe company, it is hereinafter described at considerable length in this article on the Anaconda for the reason that it treats mainly Anaconda ores and is commonly known as the Anaconda smelter. This monstrous plant, which has no peer in the world, occupies a site of 300 acres on Washoe Heights, in the outskirts of the city of Anaconda. The smelter is thirty-five miles by railroad from the mines at Butte, and was planned by Frank Klepetko and built and equipped with the able assistance of Messrs. Repath and Collins, A. G. Gulberg, chief draughtsman, and the late Wm. F. Evans. The plant began operations in January 1902, and despite persistent rumors that it was a failure has proven a great success. The maximum capacity of the plant is nearly or quite 6,000 tons daily.

The monstrous size of this reduction plant is shown by the material required in its construction, this including 20,000 tons of structural steel, 300,000 cubic yards of excavation, 50,000 cubic yards of masonry, 25,000,000 feet of lumber, and 1,000 carloads of brick. The plant may best be described under the headings of its various departments, these being the concentrating plant, sampling mill, roasters, reverberatory and blast furnaces, converter plant, briquetting department and power plant.

The concentrator covers 7 acres and is built of steel on stone foundations. It consists of two parts, each 255x355′, with a power house between and connecting. Each part contains four complete sections, giving 8 sections in all. A description of one section gives a description of the entire concentrating plant, when multiplied by eight. Each section has one 24x24″ Blake crusher, reducing ore to 3″ size. The ore then passes over two sets of trommels for sizing and the oversize material goes through two 5x15″ crushers, which reduce it to 1½″ size. Two belt elevators take the material on the main sizing floor to a series of trommels for coarse sizing. The oversize goes to coarse jigs, which produce coarse concentrates for the blast furnaces. The waste from the coarse jigs goes to two sets of 15x40″ rolls for crushing and is thence elevated and rejigged. In the jigging department all undersize material from the crusher department is treated automatically. Each jigging department has 36 double Evans jigs, set in three double rows with Evans hydraulic classifiers, making three sizes of concentrates, which go to the storage bins, while the middlings go to the middling department, which has two sets of 15x40″ rolls, crushing material to about 1¼″ size, this going by belt elevators to four sets of trommels, from which the undersize goes automatically to four hydraulic classifiers, which feed 18 double Evans jigs, set in a triple row. The process is the same as in the jigging department and the concentrates from the middlings department are mixed with the concentrates from the jigging department and go thence to the storage bins. The middlings are collected in launders and taken by elevators to the regrinding department, which has four 5′ Huntington mills, 18 double Evans jigs and 4 hydraulic classifiers. The Huntington mills are fed from V-shaped tanks, the ground material passing through 1¼″ screens and to hydraulic classifiers, thence to the jigs, both concentrates and tailings being carried by water in launders and elevators. The slime department has 35 Wilfley tables, fed from the bottom of V-shaped tanks, and concentrates from this department are taken to the storage bins, these being 24′ wide, 70′ high and 650′ long, in two sets of upper and lower bins.

The sampling mills are of brick and wood, 42x60′ and 5 stories high, in two double sections with a daily capacity of 600 tons each. These are equipped with Brunton samplers giving a final sampling of 3.2 pounds from each ton of ore.

The roasting department is of steel, on stone foundations, 98x320′, with a height of 50′ from the ground floor to the calcining floor. This building contains 48 MacDougal furnaces, each 28′ high with six roasting hearths and three platforms, the hopper above taking concentrates from hopper-cars. The hoppers have automatic feeds and each roaster has a daily capacity of about 40 tons. No fuel is required except for the preliminary heating, the sulphur furnishing all heat required after the charge is thoroughly ignited. Each furnace has an automatic discharge into two storage hoppers, these keeping calcined ores hot until taken to the reverberatory furnace. The building has sheet-iron flues that take the fumes into a dust chamber 40x300′ and 40′ high, this having concrete inner walls and a floor of steel hoppers. The smokestack of the dust chamber is self-sustaining and brick-lined, 24′ in diameter and 230′ high. The power house of the concentrator plant is 136x150′, standing between and connecting the two halves of the concentrator building proper. The power house is of steel with brick walls and has three 15-ton traveling cranes of 44′ span and contains a 1,500-h. p. Allis-Chalmers engine and two triple expansion 2,000-h. p. Nordberg engines, the latter using rope transmission. The boiler room contains ten 300-h. p. Stirling water-tube boilers. The electric machinery consists of two 700-kilowatt 2-phase Westinghouse generators; one 500-kilowatt generator and three 125-arc light generators, the latter furnishing light for the city of Anaconda as well as for the plant.

The reverberatory furnace building is of steel, 184x518′ and contains 14 furnaces, each 24x54′, set in two rows. Each furnace has five charging hoppers and one coal hopper, fed from hopper cars, the feeding of both fuel and calcined ore being strictly automatic. Each furnace has a daily capacity of 120 tons. The matte is drawn off into 20-ton ladle cars and taken to the converter department. The slag is skimmed into boxes overflowing into running water and the granulated slag is washed through launders to the slag dump. The smoke and fumes from the reverberatories are taken through underground flues, one for each row of furnaces, to a self-supporting brick lined steel stack, 24′ in diameter and 230′ in height.

The blast furnace department is a steel building 82x200′ and three stories high, the first floor carrying the railroad tracks, while the second story is the main operating floor and the third is the charging floor. This department has five furnaces, each 56x180″ and 40′ high, with a daily capacity of 400 tons for each furnace. Cupolas are made of cast-iron plates bolted, with 12 special water-jackets hung from steel beams, each furnace having 32 five-inch tuyeres. The charging floor has railroad tracks, the hopper cars being brought in by compressed air locomotives. The tracks run on each side of the furnaces, the cars being side-dumping; the charging doors of the furnace extend full length and are opened and closed by compressed air pistons and charges fed automatically. In front of each furnace is a 16′ settler, receiving a continuous flow of molten matte and slag, the matte being drawn from the bottom into 20-ton ladle cars and taken to the converters. The slag overflows into sluices and after granulation by water is washed to the slag dump. Overhead sheet-iron flues carry all fumes and smoke into a dust chamber which is an exact duplicate of that described in the calcining department.

The converter building is of steel, 137x416′ in size, and has two 60-ton electric traveling cranes with 60′ span for handling converters and ladles; also two smaller electric traveling cranes for convenience in repairs needed in the converting and casting departments. There are two reverberatory storage furnaces for the receipt of matte from the blast furnaces, these, of course, being available for use in smelting, if desired. There are 8 stands of converters, each converter being 8′ in diameter and 13′ long with eighteen 1¼″ tuyeres and ball-closing valves. There are tilting devices for handling the converters in stands and cranes for handling them when out of stands. The converters blow off into hoods with flues leading to a dust chamber similar to those already described. When the charge is blown the product is turned into ladles which are transferred by the cranes and poured into the casting furnaces, which are three in number, each of 75 tons capacity. From these the metal is drawn off and cast into pigs, or anodes for electrolytic refining. The moulds are on traveling carriages actuated by hydraulic power, and the pigs go automatically to a water-cooling tank while the slag goes to a casting machine and is made into slag brick. The converter department is supplied with a full outfit of machinery, largely automatic, for making linings for the converters, and these linings are tamped into place by ingenious machinery especially devised for the purpose.

The power house of the smelting department is of steel and brick, 80x500′ in size, and is supplied with a 15-ton electric traveling crane having a 500′ reach. The boiler house has eighteen 300-h. p. Stirling boilers. There is a Nordberg triple expansion engine with capacity to compress 20,000 cubic feet of free air per minute to a pressure of 13 lbs. per square inch. There are four Nordberg compound engines connected directly to Connellsville blowers, having a capacity of 30,000 cubic feet of free air per minute, delivered to the blast furnaces at 2 lbs. per square inch. There are also three smaller compressors for locomotives and air lifts.

The briquetting department has two machines with a daily capacity of 100 tons each, with dryers and conveyers for briquetting the flue dust, which then goes to the smelter for reduction.

The Anaconda company also operates a sawmill and has other extensive enterprises. It is the largest copper producer of the world and the second greatest producer of silver, while incidentally mining more gold than any but the world's greatest gold mines. Its annual production ranges from 80,000,000 to upwards of 100,000,000 lbs. and the cost of its copper is probably about 9½ cents per pound.

**ANACONDA PROPRIETARY COPPER, GOLD & SILVER MINE. AUSTRALIA.**

Mine office: Condobolin, Melrose Parish, Cunningham Co., N. S. W. Capitalized at £35,000, in 70,000 shares, par 10s. Opened 1885 and formerly known as the Boone West. Ore traverses country rock of ferruginous slate and brecciated conglomerate, carbonates outcropping sparingly in veins in conglomerate. Has a smelter; no returns secured.

**ANDERSON CLAIMS. CALIFORNIA.**

In Riverside county, Cal. A group of 26 claims, owned by Anderson & Co., showing vein 2′ to 6′ wide, carrying argentiferous copper ore. Development work in progress at last accounts.

**ANDERSON MINING CO. BRITISH COLUMBIA.**

Near Alberni, Vancouver district, B. C. J. C. Anderson, president. Was opening a copper ore body by tunnel, with steam power and small force, at last accounts.

**ANDES COPPER MINING & EXTRACTION CO. CHILE.**

Offices: 4, Sun Court, Cornhill, London, E. C., Eng. W. B. Brodrick, chairman; F. J. Searle, secretary. Capital, nominal, £100,000. Property, sundry mineral lands in Tarapaca, Chile.

**ANDREWS GROUP. ARIZONA.**

Near Stoddard, Yavapai Co., Ariz. J. J. Canovan, owner; no returns secured.

**ANGANG COPPER CO. MEXICO.**

Said to be operating at Chiranganguecο, Zitacuaro, Michoacan, Mexico. Stock issue supposedly owned by Arimex Co.

**ANGLO-AMERICAN COPPER MINING CO. OF PARRY SOUND, LTD. ONTARIO.**

Office and mine: Parry Sound, Ont. Chicago office: 211 State st. Organized 1900, under laws of Ontario, with capitalization $3,000,000, shares $1 par, non-assessable. Isaac Block, president; Chas. E. Bartley, vice-president; Jacob Newman, Jr., secretary and treasurer. Directors are preceding officers, H. S. Ferby and J. Spiegel. Mining lands, on Wilcox Island, near Parry Sound. Veins carry copper, silver, gold, cobalt and zinc.

Company estimates average values at 20% copper and 10 oz. gold per ton, which is manifestly improbable. Has one shaft, 125' deep. Mine can be operated open-cast to advantage. Company is endeavoring to secure a satisfactory reduction process, as the ore is refractory.

**ANGLO-AMERICAN GOLD & COPPER CO.** **MEXICO.**

Lands, 200 pertenencias in the San Domingo Mountains, between Bacuachi and Caconoche, south of La Cananea, Sonora, Mexico. Has 4 tunnels, showing ores carrying copper, gold, lead and zinc, said to assay 6% copper and $16 gold per ton. Has started a three-compartment shaft.

**ANGLO-ITALIAN COPPER SYNDICATE.** **ITALY.**

Office: probably London. Organized 1902; said to have acquired 12,000 acres of copper-bearing land near Genoa, Italy, and to have placed orders for a 500-ton smelting plant.

**ANGUS COPPER MINING & MILLING CO.**

Office: 10 North Eight st., St. Louis, Mo. No replies secured to repeated requests for information.

**ANI GROUP.** **JAPAN.**

In the province of Ugo, Japan. Mines, very ancient, recently modernized by installation of new plant. Considerable silver is secured from sulphide copper ores. Production for 1899 was about 3,000,000 lbs. copper.

**LAS ANIMAS MINE.** **MEXICO.**

Huntington, Gables & Co., owners. Mine at Santa Ana, Sonora, Mex. Produces gold, copper and lead; opened by shaft; steam power; has a 40-ton smelter; employs about 30 men.

**ANITA CONSOLIDATED COPPER CO. OF ARIZONA.** **ARIZONA.**

Office: 814 Tremont Bldg., Boston, Mass. Mine, near Williams, Coconino Co., Ariz. Capitalized at $5,000,000, shares $10 par. J. DuP. White, president; H. L. Nesmith, secretary. Mine opened by shaft and tunnels and equipped with gasoline power. At close of 1902 company was installing a $10,000 reduction plant, to be operated under a new process, devised by Wm. L. George, for the treatment of copper carbonates. Company expects to begin vigorous mining when plant is ready for operation.

**ANITA MINING CO.** **MEXICO.**

Mine office: Bolanos, Jalisco, Mexico. Has steam power equipment and 40-ton smelter. Was working nearly 100 men at last accounts.

**ANNA MINE.** **ARIZONA.**

At Providence, Yavapai Co., Ariz. Jas. Gillespie, superintendent. Supposed to be owned by Fairbanks, Morse & Co. Ores carry copper and gold values. Property developed by shaft and equipped with steam power and 15-stamp mill.

**ANNANDALE COPPER MINE.** **AUSTRALIA.**

At Blayney, N. S. W. Capital, nominal, £100,000. Was formerly known as the Great Blayney mine; reopened 1897 by present owners. Has a 40' vein of chalcopyrite, disseminated in andesite. Has smelter with two reverberatory furnaces.

**COMPANIA COBRE DEL ANTOFAGASTA DE SANTIAGO DE CHILE.** **CHILE.**

Offices: Santiago, Chile. Mines: Chuquicamata, Antofagasta, Chile. Company controls about 30 old mines in this district, and is to have a modern smelter to handle the production. Capital, $325,000. No direct returns secured.

**AO MINE.** **NEW CALEDONIA.**

Near Diahot, New Caledonia. This is a new mine, and is said to have a large ore body of good grade.

**APACHE MINE.** **NEW MEXICO.**

Office and mine: Spear, Grant Co., N. M. Robert Anderson, superintendent. Property has copper-silver-lead ores and was working a few men at last accounts.

**APOLLO CONSOLIDATED GOLD MINING CO.** **WASHINGTON.**

At Republic, Ferry Co., Wash. E. J. Delbridge, general manager. Ores carry copper, gold, silver and lead. Mine opened by shaft and equipped with steam power. About 25 men employed at last accounts.

**APOLLO COPPER MINING & MILLING CO.** **UTAH.**

Office and mine: Frisco, Beaver Co., Utah. Organized 1902, under laws of Utah, with capitalization $40,000, shares 10 cents par. Geo. A. Gilbert, president; Matilda Olsen, secretary and treasurer.

**NESTOR ARAIZA.** **MEXICO.**

Is operating copper properties at Tepezala, Aguascalientes, Mexico, according to information furnished by the Mexican government, but further details are not supplied by the government or by Señor Araiza.

**ARAKAWA MINE.** **JAPAN.**

This mine, in the province of Ugo, Japan, was opened circa 1700. Has extensive deposits of chalcopyrite, more or less argentiferous. Plant is being modernized; annual production about 2,000,000 lbs.

**ARAMO COPPER MINES, LTD.** **SPAIN.**

Offices: 2, Metal Exchange Pl., London, E. C., Eng. C. W. A. Key, secretary; Doñ Alexandro Van Straalen, director. Capital, £40,000. Mining property consists of the Aramo copper and cobalt mines, near Pola de Lena, Asturias, Spain.

**ARCADIAN COPPER CO.** **MICHIGAN.**

Main office: 24 West st., Boston, Mass. General manager's office: 402 Equitable Bldg., Chicago, Ill. Mine office: Arcadian Mine, Houghton Co., Mich. Organized March 3, 1899, under laws of New Jersey, with capitalization $3,750,000, in 150,000 shares, par $25. Albert C. Burrage, president; Sidney Chase, vice-president; Chas. D. Burrage, secretary and treasurer; A. C. Burrage, Wm. G. Rockefeller, Sidney Chase, C. D. Burrage, W. A. Paine, H. H. Rogers, C. M. King, N. F. Leopold and H. G. Foreman, directors; Nathan F. Leopold, general manager; Robert H. Shields, superintendent. Latest available financial statement, issued Dec. 1901, shows floating debt of $903,669. As considerable good machinery has since been sold and the mine's production has been turned into cash, the floating indebtedness should be smaller at the close of 1902 than one year earlier. At the annual meeting the request of a shareholder for detailed figures of costs, production, etc., was voted down by a decisive majority, the company being managed as a close corporation.

Mineral lands of the company comprise about 4,000 acres, and include six old mines, all of small development and production. The extreme length of the Arcadian tract is four miles each way, but the outline is very irregular, with a boundary line 17½ miles in length.

Immediately after the organization of the first Arcadian company, under Michigan laws, in June, 1898, a vast amount of work was begun, there having been upwards of 1,000 employes at one time. Surface improvements included the building of a considerable town, and the installation of some very powerful and costly machinery, while underground openings were pushed with great vigor. The stock of the company sold as high as $90 per share at one time, but the starting of the mill brought disappointment. Not only was the rock much lower in copper than had been hoped, but the openings were insufficient to feed the three stamps provided. At present one stamp is run on Arcadian rock, this working days only. The other heads have been leased to the Trimountain, and it is expected that one or more may be turned over to the Centennial. The Arcadian rock is now running somewhat better than 1% mineral. The mine is opened on the Isle Royale or Portage amygdaloid. Various work has been done at other points, two shafts having been opened on the Mesnard epidote, but closed because the lode was too narrow to work at a profit. Diamond drill borings are being conducted, and something over half the tract has been more or less thoroughly drilled.

Seven shafts were opened on the amygdaloid lode, and most of these were fitted with costly hoists and permanent buildings of the best design and construction. Most of the heavy machinery has been sold to the Trimountain, and mining is now being done only at the two southern shafts, "A" and "B," commonly called the Douglass shafts. The deepest of these is nearing the tenth level, and the bottom workings give the best showing found in the mine; 13 drills were running double shift, in November, 1902. The machine shop, carpenter shop, compressor and boiler houses, offices, etc., are all of the best plan and material, and it is much to be regretted that the expenditure of the vast sums lavished on the Arcadian has not resulted in the making of a better mine, though the results now being obtained from the Douglass shafts are the best ever secured in any part of the property.

**ARDILLA COPPER MINES., LTD. PORTUGAL.**

Offices: 20–21, Lawrence Lane, London, E. C., Eng. Maj. H. S. Fleming, chairman; A. L. Pulido, mine manager; W. Cooper, secretary. Capital, nominal, £120,000; issued, £108,080. Property, 11 mining concessions, area 1,331 acres, on the Ardilla river, department of Barrancas, Province of Alemtejo, Portugal.

**ARGHANA MADEN MINES. TURKEY.**

Located near the town of Arghana Maden, Turkey, and owned by the crown. Annual output, about 1,500 metric tons of fine copper, shipped as an 80% matte. Ores said to be of exceptional richness.

**ARGO MINING CO.** **MONTANA.**

Near Canyon Ferry, Lewis & Clarke Co., Mont. H. W. Carroll, superintendent. Was developing a copper-gold ore body by tunnel, with small force, at last accounts.

**ARGYLE MINING CO., LTD.** **ARIZONA.**

Offices: 194, St. Vincent St., Glasgow, Scotland. See Mineral Hill Syndicate.

**ARIMEX CONSOLIDATED COPPER CO.** **ARIZONA & MEXICO.**

Office: 85 Ames Bldg., Boston Mass. Organized under laws of New Jersey, with capitalization $5,000,000, shares $25 par. Chas. H. Dickey, president; C. D. Burrage, secretary. American Loan & Trust Co., Boston, transfer agent. Property includes Copper Prince group of 30 claims in the Silver Bell district, Pima Co., Ariz., this being held through the Oxide Copper Co., of New Jersey. Company also owns 87½% of stock issue of the Table Mountain Copper Co., which has 27 claims in the Bunker Hill mining district of Pinal Co., Ariz.; also 90% of the stock issue of the Angang Copper Co., which has about 400 mining claims at Zituacuaro, Michoacan, Mexico, these being known as the Chiriangangueco mines. Neither of the Arizona properties is considered of especial promise, but the Mexican claims are regarded as valuable, by good judges.

**ARIZONA BLUE BELL COPPER CO.** **ARIZONA.**

Office: 71 Broadway, New York. Mine office: Mayer, Yavapai Co., Ariz. Organized under laws of Delaware, with capitalization $500,000, shares $1 par. C. A. Hamilton, president; A. Howard Hinkle, vice-president; M. L. Bouden, secretary and treasurer. Directors are preceding officers, C. M. Warner, Alexander Nones, H. H. Ward, Seymour Scott, J. Edw. Addicks, G. C. Edwards, Jacob Amos, J. Frank Alee and H. A. Bispham. Ernest A. Haggott, superintendent. Has steam and gasoline power. Has constructed a six-mile railroad from mines to Mayer and purposes building a large smelter at Del Rio, about 20 miles north of Prescott. Property said to show a very large amount of good ore and it is claimed that the ore body on the 300′ level is nearly 500′ wide.

**ARIZONA CENTRAL COPPER CO.** **ARIZONA.**

Was prospecting under direction of M. Salzman, near Williams, Coconino Co., Arizona, at last accounts.

**ARIZONA COMMERCIAL CO.** **ARIZONA.**

Office: 11 Pine St., New York. Mine office: Globe, Gila Co., Ariz. Organized 1882, under New York laws, with capitalization $1,000,000, shares $10 par. Sigourney W. Fay, president; J. H. Fay, secretary and treasurer; N. L. Amster, consulting engineer; W. S. Sultan, superintendent. Lands, 10 claims, just north of Old Dominion mine. Main shaft, on the Copper Hill claim, 400′, showing oxide and carbonate ores near surface, succeeded by sulphides at depth, with 8′ sulphide vein of fair grade at bottom of shaft. Work suspended, July, 1902. Company understood to contemplate installation of concentrating plant.

**ARIZONA CONSOLIDATED COPPER MINES, LTD. ARIZONA.**

Offices: 80, Coleman St. London, E. C., Eng. Properties, if any, presumably in Arizona, but no returns secured.

**ARIZONA COPPER CO., LTD. ARIZONA.**

Offices: 29, St. Andrew Sq., Edinburgh, Scotland. Mine office: Clifton, Graham Co., Ariz. Capital, nominal, £755,000 in 160,000 "A" preference shares of 5 shillings, £320,000 cumulative 7% preference shares, £320,000 preferred ordinary stock and £75,000 deferred ordinary shares. Debentures; £230,474 bearing 5%. W. J. Menzies, chairman; W. E. Miller, secretary; Jas. Colquhoun, general manager; Geo. Fraser, superintendent; Walter A. Moore, mill superintendent. Production of refined copper for 1901 was 20,535,800 pounds. Output for 1902 was probably about 30,000,000 pounds and for 1903 should show an increase. Company stated to be producing copper for less than 7 cents per pound, at close of 1902. Dividends, for year ending Sept. 30, 1901, were £298,543.

Principal mines owned by the company are the Longfellow, Humboldt and Yavapai, near Clifton and Morenci, Graham Co., Ariz., the Longfellow having been the first copper mine opened in Arizona. Ore occurs as disseminated sulphides and is mined open-cast, product from the pits, averaging about 4% copper, being concentrated by rolls and jigs. Sulphuric acid is made from the fumes of the roasters and used extensively in leaching copper from immense bodies of low-grade oxide and carbonate ores.

The new reduction plant at Clifton went into commission August 1, 1901. Concentrator and smelter are connected by gravity railway. Area of mining property, about 4,000 acres. Company owns the Arizona & New Mexico Railway, 70 miles in length, standard gauge, to be extended to connect with the Santa Fe Railroad, thus giving two freight routes. Extensive improvements have been made during 1902, including new car shops, carpenter shops, roundhouse, etc., for the railroad, all of brick, aggregating an expenditure of about $1,000,000. Six new converters were added to the smelter late in 1902. Mine is equipped with steam, gas and electric power, and employs about 1,500 men. Property is economically and ably handled and ranks in output among the world's ten largest mines.

**ARIZONA COPPER & GOLD MINING CO. ARIZONA.**

B. F. Porter, president and A. W. Gregg, secretary, at last accounts. Letter to company's office, Phœnix, Arizona, returned unclaimed, October, 1902.

**ARIZONA COPPER HILL MINING CO. ARIZONA,**

Office: Jackson Bldg., Denver, Colo. Mine office: Tucson, Pima Co., Ariz. Property active. Organized 1900, under laws of Arizona, with capitalization $1,000,000, shares $1 par. Edwin Scott, president; Phil. Bennett, vice-president; J. H. Edwards, secretary; W. W. Howland, treasurer. Directors are preceding officers and E. Salisbury Smith. Frank J. Buck, superintendent. Lands, 4 patented claims, area 65⅔ acres, also 5-acre millsite and 160 acres other lands, in the Canada Del Oro district of Pinal Co., Ariz. Mine works contact vein of 20′ to 70′ width, with total length 4,817′, giving estimated average values of 4% copper, from carbonate ores. Has shafts of 281′ and 350′, also tunnel 350′ and 2,000′ of underground openings. Estimated amount of ore blocked out for stoping, 350,000 tons. Has gasoline and steam power plant. Will have 100-ton leaching plant in operation early in 1903. Nearest railroad, Southern Pacific, 32 miles. Company has no debts and will continue development work.

**ARIZONA COPPER MOUNTAIN MINING CO. ARIZONA.**

Office: 116 Nassau St., New York. Local office: Phœnix, Ariz. Employs 8 men in development work. Organized 1900, under laws of Arizona, with capitalization $6,000,000, shares $1 par, non-assessable. Augustus C. Sheldon, president and general manager; Benj. C. Sheldon, secretary; Prosper P. Parker, vice-president; Morton Trust Co., New York, treasurer; preceding officers with A. P. Abell, Wm. E. Albee, Wm. E. Ellis and John R. Waller, directors; Allen G. Wilson, superintendent. Mining lands, 20 unpatented claims, area nearly 400 acres, also 40-acre millsite, in Mineral Creek district, 5 miles west of Ray, Pinal Co. Formation is an upheaval between granite and limestone, erupted matter topped by 200′ capping of porphyry. Deposit said to be a blanket vein 1,300′ wide, 4,000′ long and developed to depth of 200′, with estimated average value of 8% copper. Ores, carbonate and oxide near surface, sulphide at a little depth. Has about 20 shafts, from 10′ to 200′ deep and 4 tunnels, longest 300′. Has steam power, shops, etc. During 1903 company contemplates opening a breast 300′ long by 150′ wide, building aerial tram 1¼ miles, installing a full mining equipment and building a smelter of at least 100 tons daily capacity.

**ARIZONA COPPER PLACER MINING & MILLING CO. ARIZONA.**

Said to be operating near Quartzite, Yuma Co., Arizona, but no returns secured.

**ARIZONA COPPER SYNDICATE, LTD. ARIZONA.**

Offices: care of Foreign Syndicate, Ltd., Moorgate Station Chambers, London, E. C., Eng. Said to have property in vicinity of Clifton, Graham Co., Arizona, but no definite information secured.

**ARIZONA GIANT COPPER CO. ARIZONA.**

Office: Los Angeles, Cal. Mine office: Ehrenburg, Yuma Co., Ariz. N. G. Douglass, president; J. H. Eigholz, secretary. Lands, 320 acres. Makes very extensive claims in its prospectus and newspaper advertisements, but persistently refrains from furnishing detailed information for this work.

**ARIZONA GOLD & COPPER CO. ARIZONA.**

Office: 30 Broad St., New York. Mine office: Patagonia, Santa Cruz Co., Ariz. Organized 1900, under Arizona laws, with capitalization $1,000,000, shares $1 par. Annual meeting, last Tuesday in January. Floyd B. Wilson, president; Wm. H. Gray, treasurer; Fred K. Jones, secretary; Geo. W. Crowe, general manager. Lands, 140 claims, in Tyndall district of Santa Cruz Co. Has 7 shafts, also tunnel. Company claims large assay values. Ore body has extreme width of 4′. Has 80-ton smelter at Patagonia and has expended large sums in development and improvement. No returns secured for 1902.

**ARIZONA GOLD & COPPER REDUCTION CO.**

A Theodore Stegner enterprise, with numerous adresses, to none of which letters addressed were delivered.

**ARIZONA MINE.** **WYOMING.**

Near Hecla, Laramie Co., Wyo. Horace E. Adams, owner. Has gold-silver-copper ores, opened by shaft; steam power; 5 stamps and leaching plant.

**ARIZONA UNITED COPPER CO.** **ARIZONA.**

Office: 35 Wall St., New York. Edmund D. Willetts, president, at last accounts. No returns secured and company probably moribund.

**ARIZONA & ARKANSAS COPPER, LEAD & ZINC MINING CO.** **ARIZONA.**

Office: probably Los Angeles, Cal. Lands, about 85 miles west of Phœnix, Ariz. E. I. Bryant, president: no returns secured.

**ARIZONA-COLORADO COPPER BELT & GOLD MINING CO.** **ARIZONA.**

Offices: said to be in Denver and Chicago. Developing the Baltic and Little Beauty claims, 3 miles north of Globe, Gila Co., Ariz. Judge R. M. Foree, president. Company has secured some very good assays.

**ARIZONA & HANCOCK MINING CO.** **ARIZONA.**

Office: Hancock, Mich. Mine office: Globe, Gila Co., Ariz. Formerly known as the Pinto Creek Copper Co. Employs 25 men. Organized 1901, under laws of Arizona, with capitalization $250,000, shares $1 par, non-assessable. John D. Cuddihy, president; Alfred C. Sieboth, vice-president and superintendent; Henry L. Baer, secretary and treasurer. Directors are preceding officers, Alfred Mann, Chas. L. Mann, Chas. D. Hanchette and Phillip Carroll. Mining lands, 19 claims, near Globe. Ores, sulphide. Property developed by 250′ shaft and 400′ crosscut. Steam power. Nearest railroad, 12 miles. Will continue development in 1902.

**ARIZONA-MEXICAN COPPER CO.** **MEXICO.**

Office: Phœnix, Ariz. Mine office: Caborca, Sonora, Mexico. Organized 1902, under laws of Arizona, with capitalization $3,000,000, shares $10 par. Organized under laws of Mexico as La Gran Proveedora de Cobre, stock of which is entirely owned by the Arizona corporation. J. E. Hubinger, president; L. H. Chalmers, vice-president; W. C. Foster, secretary; R. H. Greene, treasurer; W. E. Defty, general manager; John Henderson and Prosper Sandoval, superintendents. Mining property, area 50 acres, near Caborca, in the Altar district of Sonora, is 75 miles from Santa Ana, on the Sonora Railway, and 40 miles from Puerto Lobos, on the Gulf of California. Main outcrops lie between well-defined walls and measure 265′ in width. Active development begun Nov. 25, 1902, by sinking vertical shaft on the vein, near the hanging wall, and driving tunnel from a point near the footwall to join the shaft at bottom. When junction is effected, development will continue in four directions. At close of year tunnel had cut 40′ of solid ore, improving in quality with every foot of progress made, and was breasted in solid chalcocite. Surface ores consist of a gossan capping of hydrated peroxide of iron, carrying copper carbonates and good assay values of gold and silver. Country rock is limestone, with gossan capping over entire formation. Company will continue vigorous development and contemplates equipping property with smelter as soon as sufficient reserves have been secured and characteristics of ore body have been fully ascertained. Property is one of exceptional promise.

**ARLINGTON COPPER CO. NEW JERSEY.**

Office: 2 Wall St., New York. Mine office: Arlington, Bergen Co., N. J. Organized 1900, under laws of New Jersey, with capitalization $2,500,000, shares $10 par. Bonded debt $260,000. Wm. McKenzie, president; Henry G. Bell, treasurer; Chas. L. Dignowity, general manager. Company owns the old Schuyler mine, opened in 1719. Company installed a good mechanical plant for producing copper by leaching and electrolysis, but the process did not prove successful. Work was suspended at close of 1901.

**ARMINIUS CHEMICAL CO. VIRGINIA.**

Office: 56 Wall St., New York. Rowland F. Hill, president; W. Maw, secretary and treasurer; W. H. Adams, superintendent. Company was operating the Arminius mine, at Mineral City, Louisa Co.,Va., circa 1899. No returns secured.

**ARNOLD MINING CO. MICHIGAN.**

Office: 50 State St., Boston, Mass. C. L. Davenport, president; John Brooks, secretary and treasurer; Wesley Clark, superintendent. Organized under Michigan laws, with capitalization $2,500,000, par $25; issued, $1,550,000. Annual meeting, second Tuesday in May. Property, 3,323 acres, in Town 58 North, Range 31 West, and Town 58 North, Range 30 West, Keweenaw Co., Mich. Lands are in two tracts, comprising the old Copper Falls mine and the Arnold mine proper, with frontage of about 3 miles on Lake Superior. Property lies north of the greenstone. Copper Falls mine worked, circa 1850 until August, 1893, making 12,843 tons, 429 pounds copper and paying dividends of $100,000; product secured mainly from the Owl Creek fissure vein. Arnold mine is developed on the Arnold ashbed; opened 1863, reopened 1897, closed 1901. Copper secured, under 0.8%. Has stamp mill and 2½ mile narrow gauge railroad, known as Arnold & Eagle Harbor, with one Baldwin locomotive and 7 cars. No. 1 shaft of Arnold is about 1,000′ deep and sunk at an incline of 26°.

**ARPS CLAIMS. CALIFORNIA.**

Fifteen claims, in Town 34 North, Range 3 West, Shasta Co., Cal. Owned by Wm. Arps, et al., of Redding, Cal. Have 4 tunnels, aggregating 1,600′, with fair showing of sulphide ore.

**ARTOLA HERMANOS. CHILE.**

Operate the Gatico mine, opened 1891, in the department of Cobija, Chile. Product, shipped as matte, is equivalent to an annual output of 1,000 to 2,000 tons of refined copper.

**ASHBED MINING CO.** **MICHIGAN.**

Office: 50 State St., Boston, Mass. Organized 1880, under laws of Michigan, with capitalization $1,000,000. Lands, 1,143 acres in vicinity of Copper Falls, Keweenaw Co., Mich. Property idle. Wesley Clark, superintendent; fully described in 1902 edition.

**ASHIO MINE.** **JAPAN.**

See Furukawa Copper Company, owners.

**COMPANIA MINERA DE ASIENTOS.** **MEXICO.**

Office: Baltimore, Md. Mine office: Asientos, Aguascalientes, Mex. Harry Rab, superintendent. Property includes Nopensada and other mines, producing copper and silver. Main shaft, 200′. Has steam and electric power and employs about 200 men.

**SOCIETE CIVILE DES MINES DE CUIVRE D'ASPEICH.** **FRANCE.**

Offices: Rue de Milan, 3, Paris, France. G. Caton, director. Property is in the Basses Pyrenees, France.

**SOCIEDAD INDUSTRIAL DE ATACAMA.** **CHILE.**

Operates Tierra Amarilla mine, opened 1857, in department of Copiapo, Chile. Has a smelter at Caldera, Atacama, Chile, and secures annual production of 1,800 to 2,000 tons copper, shipped in the form of bars and matte.

**ATACAMA MINERAL CO., LTD.** **CHILE.**

Offices: 8, Eastcheap, London, E. C., Eng. C. W. Armitage, chairman; J. Peters, secretary. Capital, nominal, £30,000. Property, mining lands at Taltal, Atacama, Chile.

**ATHELSTAN GOLD MINING CO., LTD.** **BRITISH COLUMBIA.**

Mine at Grand Forks, Yale & Cariboo district, B. C. Ores carry gold, silver and copper; mine opened by shafts; steam power; about 30 men employed. John Mack, manager.

**ATLANTIC MINING COMPANY.** **MICHIGAN.**

Office: 11-13 William St., New York. Mine office: Atlantic Mine, Houghton county, Michigan. Is a large and regular producer, working about 700 men. Organized December 1872, under laws of Michigan; reincorporated in 1901 for term of 30 years. Capitalization increased in 1902 to $2,500,000, in 100,000 shares, par $25, and $9.80 paid in. Annual meeting, second Tuesday in March. Jos. E. Gay, president; John Stanton, secretary and treasurer; directors are preceding officers, John R. Stanton, Wm. C. Stuart, J. Wheeler Hardley, Wm. A. Paine and Samuel L. Smith. Frank McM. Stanton, superintendent; F. W. Denton, assistant superintendent; F. G. Coggin, mill superintendent; John Stratton, mining captain, succeeding W. S. Trethewey; A. D. Edwards, clerk; Theo. Dengler, mining engineer.

| | |
|---|---|
| Amount cash paid in on capital stock | $280,000.00 |
| Amount paid in by conveyance of property to company | 700,000.00 |
| Entire amount invested in real estate | 45,349.66 |
| Amount of personal estate | 278,346.29 |
| Amount of unsecured or floating debt | 182,646.64 |
| Production of copper, 1901, in pounds | 4,666,880 |

From organization to Jan. 1, 1902, income and expenditures have been as follows:

| | |
|---|---|
| Total income from all sources | $14,473,024.57 |
| Total expenditures for all purposes | 13,437,324.92 |
| Dividends paid | 940,000.00 |
| Net surplus | 95,699.65 |

Comparative figures for four years are as follows:

| | 1901 | 1900 | 1899 | 1898 |
|---|---|---|---|---|
| Mineral produced, lbs | 6,317,645 | 6,577,955 | 6,147,555 | 5,926,450 |
| Refined copper, lbs | 4,666,889 | 4,930,149 | 4,675,882 | 4,377,399 |
| Total income | $735,577 | $800,177 | $802,804 | $518,219 |
| Expenses at mine | 573,341 | 555,254 | 508,148 | 440,373 |
| Smelting and transp'n | 62,954 | 60,311 | 63,009 | 59,479 |
| Total cost | 636,296 | 615,556 | 573,027 | 499,852 |
| Mining profits | 99,281 | 193,621 | 229,777 | 18,366 |
| Land sales | 11,600 | ...... | ...... | ...... |
| Construction | 191,143 | 114,007 | 78,527 | 69,630 |
| Balance | def 80,262 | 79,613 | 151,250 | def 51,263 |
| Dividends | ...... | 80,000 | 80,000 | ...... |
| Surplus | 95,699 | 175,962 | 176,348 | 105,098 |

The Atlantic mine is located about 2 miles south of Portage Lake and some 4 miles southwest of Houghton. The main tract of 640 acres includes the properties known as the South Pewabic and Adams mines before 1872. It has the Pacific on the north; Isle Royale and undeveloped lands on the east; Isle Royale and undeveloped lands on the south, and Canal lands and the Pacific on the west. The lands are all on the mineral belt, being the south half of Section 4, except the southeast quarter of the southeast quarter; the north half of Section 9, and the northwest quarter of the northwest quarter of Section 10, all in Town 54 North, Range 34 West. The company also owns all of Section 16, same town and range, bought in 1897, which is undeveloped beyond an exploring shaft from which crosscuts have been sent east and west, in search of the Baltic amygdaloid.

The mine is opened on an amygdaloid of brownish, mottled color, averaging about 15' wide, with a strike of N.50°E., and a dip of 54° to 55° to the northwest. The lode is known locally as an ashbed, and greatly resembles the ashbed of the Arnold and adjacent mines; is apparently in line of the southwesterly continuation of the Keweenaw county ashbed, and is the most westerly of the copper-bearing beds worked in Houghton county. It also carries the least copper of any lode now worked, and has been famous for years for its profits, wrung from rock yielding much less than 1% ingot copper. The low percentage of copper carried by the lode is a decidedly adverse factor, but the mine, under its present management, has met and survived nearly every trouble that copper mines are liable to, these including lean rock, mine fires, costly equipment necessitated by deepening shafts, new mills rendered obligatory by the government removing all mills depositing sands in the Portage Lake channel, and the building of a private railroad required for the traffic of the mine. To offset the low grade of the rock, there are certain marked advantages. The ashbed is the softest rock mined in the district; it requires less power in drilling, less dynamite in breaking, and less steam in stamping, than any other lode; the rock breaks well and everything is mined, from wall to wall. The best of the lode is so low in copper that no assorting is attempted. The mine has an able and economical management, and is often quoted by mining men and the technical press as the finest example of a successful low-grade mine to be found anywhere. The mining location is one of the neatest imaginable. There are about 250 dwellings owned by the company, and nearly as many more owned by employes. There are several churches, and a graded school that ranks among the best in Michigan. The Atlantic affords an example of thrift and economy that can be studied to advantage.

The shafts of the mine are lettered in order from north to south from "A" to "F," giving a total of six shafts. The production is now secured from "A," "B," and "D" shafts.

"A," the northernmost shaft, was started in 1897, to open newly purchased ground. It is sunk at an angle of 54°, or one degree flatter than the other shafts of the mine, and is the largest in dimensions of any of the six, being 9x20′ inside of timbers, with three compartments, two of which are skip-ways, the third for men and pipes. The surface improvements at this shaft, completed in 1899, consist of a shaft-rockhouse 35x67′ on the ground and 84′ high, of frame construction, fitted with four rock-crushers. There is a boiler-house, 38x50′ in size, with redstone walls and steel truss roof, also an engine-house, 48x50′, of the same construction as the boiler-house, containing a 26x48″ double Corliss engine of Allis-Chalmers manufacture. This is so built that it can be compounded later, when greater depth necessitates more economy in steam consumption. The hoisting is done over a double conical drum having a diameter of 10′ at either end, and of 15′ 6″ in the center. Nine-ton skips are hoisted. The shaft itself is 1,377′ northeast of "B" shaft, and is 650′ deep.

"B" shaft has two compartments, both used for skip-tracks, there being no man-way. Underground the shaft is looking well, and on surface is fitted with a magnificent new hoisting paint. The hoist is of Corliss pattern and Allis-Chalmers make, with a double conical drum, the engine and drum being similar in design to the plant at "A" shaft, but much larger throughout. The drum is 12′ in diameter at each end and 24′ 4″ in diameter at the middle, where there is a cylindrical section 18″ wide, the balance of the drum tapering sharply in both directions. The drum has a 22′ face and in itself weighs 140 tons. All grooves are lathe-turned, for 1¼″ steel cable. The hoist is operated in counterbalance and is good for a depth of 4,000′. Owing to its working in balance, eleven-ton skips are hoisted with ease at the rate of 3,400′ per minute. It is built for operation at a steam pressure of 100 pounds to the inch, and is direct-acting and non-condensing. There are band brakes at either end, set by gravity and instantaneously released by steam power. This is one of the finest hoists in the district. "B" shaft is 2,190′ deep at the close of 1902.

"C" shaft, next southwest, was abandoned after the fire of 1898.

"D" shaft, 1,465′ southwest of "B," is the deepest and best shaft of the mine, being 2,870′ deep at the close of 1902. It is 9x18′ in size, inside of timbers, being of nearly as large size as "A," and has three compartments, two for skips worked in balance. The engine-house is 48x60′ in size, of redstone with steel truss roof. The hoist is of Nordberg make, and in essential features a duplicate of the powerful hoists installed at various shafts of the Osceola, Kearsarge and Isle Royale mines. It operates in balance and is calculated to hoist six-ton skips from a depth of one mile. The boiler-house has four Stirling boilers, of 150 horse-power each. The shaft is looking well in nearly all of the present stopes, and gives promise of good rock for the future. It commands a large territory, and will do the lion's share in keeping up Atlantic production for some years to come.

"E" shaft, 2,440′ deep, is used for a man-way and air and water pipes, no rock being hoisted therefrom.

"F" shaft is 478′ southwest of "D," and was long a large producer. It was 2,146′ deep when put out of commission in 1902.

A 50-drill Ingersoll-Sergeant compound air-compressor went into commission in December, 1901, and gives efficient service. Among miscellaneous buildings are the compressor houses, "drys," carpenter, blacksmith and machine shops, and a sawmill, at the mine. There is a fire department, with apparatus and complete volunteer brigade, also fire pumps in the principal buildings.

The Atlantic stamp mill is at Redridge, on Lake Superior, and was built 1894–95. The building is 151x234′ in size, of wood, on stone foundations. Water is furnished from a dam across the mouth of the river, a description of which will be found in the article on Baltic. There is about two miles of lake frontage, affording sand ample room. The mill has six stamps with 18″ cylinders, which when first installed crushed about 300 tons each daily. Solid foundations were placed under the heads in 1898–99 and condensers were added early in 1900, these improvements increasing the capacity of each stamp about 50 tons daily, without marked increase in running cost. Power is supplied by a 14x42″ Reynolds engine of Corliss pattern. There is a 7x14x12″ Gardner fire pump in the mill, also a similar pump in the boiler house adjoining, for protection against fire. A machine shop is fitted up in the mill, and supplied with all tools required for repair work and fitting at that point. Adjoining the mill is the boiler house, also of wood, on stone walls, 71x101′ in size. A Green fuel economizer was added in 1899, and has worked successfully, saving about 12% in fuel bills. At the millsite there is a good frame warehouse, 30x36′ in size, store building, smithy, and a number of comfortable dwellings for employes.

The Atlantic railroad, owned by the company, connects mine and mill with 9 miles of main line. A branch line runs 3 miles from the mine to the old millsite on Portage Lake, where there are large coal and merchandise wharves for receipt of fuel and supplies. The railroad has 4 Baldwin and 1 Brooks locomotives, 130 hopper cars for rock and coal, and 60 flat cars for wood and general freight. The mine is on the main line of the Copper Range railroad.

The mill is now stamping about 1,500 tons of rock daily and the percentage of copper secured therefrom showed an increase toward the close of 1902. Explorations on Section 16, in search of the Baltic amygdaloid, have not been successful, but are being continued with dogged persistence.

**ATLAS COPPER SYNDICATE, LTD.**

Offices: St. James Square, Manchester, Eng. Corporation was organized "to acquire mines." No returns secured.

**AUSTRALIAN COPPER SYNDICATE, LTD.**

Offices: 2, Royal Exchange Ave., London, E. C., Eng. A corporation formed "to acquire mines anywhere in the world." No returns secured.

**AUSTRALIAN MINING CO. AUSTRALIA.**

Offices: 42, New Broad St., London, E. C., Eng. Owns 20,000 acres of mineral land in the Reedy Creek district, South Australia. Has not mined since 1858. Owns the Tungkello mine, leased to Kitticoola Gold-Copper Co.

**AVINO MINES OF MEXICO, LTD. MEXICO.**

Offices: Basildon House, Moorgate St., London, E. C., Eng. F. L. Gardner, chairman; Chas. B. Flynn, managing director at mines; W. Bramall, secretary. Capital, nominal, £1,000,000; issued, £888,422. Property, 610 acres of gold, silver and copper lands, also a dam site, 302 acres, at Avino, Durango, Mex. Mine extensively opened by shafts and tunnels and equipped with steam and electric power. Has 400-ton concentrator; employed about 500 men at last accounts.

**AZTEC COPPER CO. MICHIGAN.**

Property, 190 acres, lying just east of Hilton mine of Adventure Consolidated, in Ontonagon county, Mich. Production, 353 tons, 863 lbs., of which 100 tons was secured in a single mass. Idle many years. Company neglected to pay taxes, but tax titles were set aside in company's favor, November, 1901.

**AZTEC COPPER MINING & SMELTING CO. MEXICO.**

Office: 907 Stephen Girard Bldg., Philadelphia, Pa. Mine office: Rancho del Almirez, Jalisco, Mexico. Capitalization, $300,000. Dr. Pemberton Dudley, president; John R. Williams, general manager; C. D. Lance, secretary; Isaac S. Smith, Jr., treasurer. No returns secured in response to repeated requests.

**AZTEC GOLD & COPPER MINING CO. COLORADO.**

Office: 53 State St., Boston, Mass. Mine office: Needleton, La Plata Co., Colo. Employs 15 men. Organized 1899, under laws of Maine, with capitalization $2,000,000, shares $1 par, non-assessable. David W. Williams, president; Lyman Jordan, vice-president; Geo. F. Bradstreet, secretary and treasurer; preceding officers, Herbert F. Doble, Chas. A. Howland, W. W. Brookings, N. P. Cummings, F. E. Chandler and C. W. Davis, directors; W. Z. Kinney, general manager; Josiah Moore, superintendent; C. K. Colvin, mining engineer. Lands, 40 claims, area 500 acres, all in process of patenting.

Development work is being done on 2 fissure veins, average width 2′, estimated length 3,300′, with estimated average value $18 per ton. Ores, sulphide; development tunnel, 960′, goes in on the vein, piercing the mountain. Has already cut 5 ore bodies and is improving as depth is obtained; will give about 1,000′ of back, for stoping, in centre of mountain. Large water power being developed, enough to run the mine and sell a surplus to adjoining properties. Considerable amount of ore on dump ready for milling. High-grade ore being selected for shipment in spring of 1903. Company plans erecting a concentrator in 1903.

**AZURITE COPPER & GOLD CO. ARIZONA.**

At Tucson, Pima Co., Ariz. Operated by L. Zeckendorff & Co. Has copper-gold ores, developed by shaft. Steam power equipment and 70-ton smelter. Worked a small force at last accounts.

**BABCOCK & KITTERMAN GROUP. OREGON.**

At Althouse, Josephine Co., Ore.; prospecting work in progress at last accounts.

**BADEN-BADEN GOLD MINING CO. COLORADO.**

At Black Hawk, Gilpin Co., Colo. Newell Bros., managers. Has gold-silver-copper ores; steam power; about 25 men employed at last accounts.

**BADGER COPPER CO. WYOMING.**

Organized July, 1902, to conduct operations in Albany Co., Wyoming, with headquarters at Laramie, but letter addressed to company returned unclaimed, October, 1902.

**BADGER MINE. COLORADO.**

On the Platte river, 12 miles east of Pearl, Colo. Owned by Alex. Hilton, et al. Has a limited amount of development work, with good showing of high-grade ores.

**BADGER STATE MINING & MILLING CO. WYOMING.**

At Saratoga, Carbon Co., Wyo. Gus Jensen, president. Was working small force at last accounts.

**BALADE MINE. NEW CALEDONIA.**

Address: probably Noumea, New Caledonia. This is a new copper property, said to possess merit; efforts to secure details for this work were not successful.

**BALAKLALA MINING CO. CALIFORNIA.**

Office: 222 Bush St., San Francisco, Cal. Property, near Copley, Shasta Co., Cal. C. A. Malm, president; W. W. Adams, superintendent. Lands, 26 claims, 13 patented, with about 35 outlying claims. Principal development on El Capitan group, which is opened by tunnels. Ore body on 400′ level is 60′ to 100′ wide; ore ranges in value from poor to good. Diamond drilling has proven extensive ore body and also shows additional deposits of apparently higher average grade, 100′ below the main body. Ore occurs in lenses, largest about 50x500x700′.

**BALD MOUNTAIN MINING CO. WASHINGTON.**

Near Clear Lake, Skagit Co., Wash. A. H. Rogers, superintendent. Was driving tunnel at last accounts.

**BALHANNAH COPPER & GOLD MINE, LTD.**

Gave address as Broad St. House, London, E. C., England; not found by postal authorities in London.

**BALKAN COPPER CORPORATION, LTD.** **TURKEY.**

Offices: 4, Redcross St., London, E. C., Eng. Sir O. R. Slacke, chairman; J. Rowley, managing director; E. A. Foster, secretary. Capital, nominal, £250,000. Property is the Yardimly copper mine, area 7,900 acres, and the Chapzi-Hane mine, area 2,500 acres, both situated in the Rhodope Mountains, northwest of Constantinople. Mines are held on annual rental of £420 and 5% royalty on gross production.

**BALLA-BALLA MINE.** **AUSTRALIA.**

In the Pilbarra district of West Australia. Is developing carbonate and oxide ores, exposed at surface and worked open-cast.

**BALTIC MINING CO.** **MICHIGAN.**

Office: 11-13 William St., New York. Mine office, Atlantic Mine, Houghton Co., Michigan. In active operation and a large producer, working upwards of 500 men. Organized December 1897, under laws of Michigan, with capitalization $2,500,000, in 100,000 shares, par value $25 each, $18 paid in. Annual meeting, first Monday in March. John Stanton, president; John R. Stanton, secretary and treasurer; John Stanton, Joseph E. Gay, Wm. A. Paine, S. L. Smith and Cameron Currie, directors. Frank McM. Stanton, agent; F. W. Denton, superintendent; John Jolly, mining captain; Wm. C. Cole, clerk; Theodore Dengler, mining engineer; F. G. Coggin, mill superintendent. Practically entire stock issue of the Baltic company is held by the Copper Range Consolidated Company, since December, 1901.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902. disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,795,092.00 |
| Amount paid in by conveyance of property to company | 1,000,000.00 |
| Entire amount invested in real estate | 1,014,751.00 |
| Amount of personal estate | 99,182.35 |
| Amount of unsecured or floating debt | 170,742.29 |
| Production of copper, 1901, in pounds | 2,641,432 |

Total production of refined copper to close of 1901 has been 5,300,328 pounds. In 1901 the net income from copper produced was $433,947.78, and total running expenses were $379,208.88, leaving actual mining profit of $54,738.90. Construction account for new buildings, machinery, etc., including the new stamp mill, reached $434,990.37, beside which $13,750 was paid for the millsite and timber lands.

Mineral lands, 800 acres, lie near the Eastern sandstone, a portion, approximately 75 acres, being on the sandstone. The tract comprises all of Section 21 except the southeast quarter, and the west half of Section 20, Town 54 North, Range 34 West. The Baltic is bounded on the north by the Wheal Kate and the Section Sixteen tract of the Atlantic; on the east by lands of St. Mary's Mineral Land Co.; on the south by Canal lands, a tract owned by Hussey, Howe & Co., and the Trimountain, and on the west by the Trimountain. The

Baltic is two and a half miles south of the Atlantic mine in almost a due line, and its northernmost shaft is not quite four miles southwest of No. 10, the southernmost shaft of the Huron mine of the Isle Royale. To the southward the Trimountain and Champion mines are opened on the same lode as the Baltic.

The Baltic shafts are numbered from south to north, with the exception of No. 2, which is south of No. 1, the discovery shaft. No. 2, the southernmost shaft, is nearly one-half mile north of the southwestern boundary of the Baltic lands, following the Baltic lode's strike produced, and is 260′ deep. No. 1 is 535′ northeast of No. 2 and is 219′ deep. No. 3 is 635′ northeast of No. 2 and is 695′ deep; No. 4 is 900′ northeast of No. 3 and is 663′ deep. No. 5 is 855′ northeast of No. 4, and is 456′ deep. This gives a stretch of 3,025′ between the extreme shafts, in addition to which several hundred feet have been proven by the north drifts from No. 5. No. 1, the discovery shaft, being too crooked for permanent use, was abandoned. No. 2 was the first producing shaft, and remains an important source of rock supply. No. 3 is the principal shaft of the mine. The tempory plant at No. 3 was burned April, 1901; a new hoist, of modern design and great capacity, was put in commission June, 1902. The engine house, 38x50′, is of steel frame with concrete filling. The shaft-rockhouse is 35x71′, with wing 17x31′, and is 88′ high, of wood sheathed with steel. This has a 16x18″ engine, two 18x24″ Blake crushers and bins with 1,400 tons storage capacity.

No. 4 shaft is to have a powerful new Allis-Chalmers hoist in 1903. A steel shaft-rockhouse was built around the former wooden structure in 1902. The equipment will be practically a duplicate of that at No. 3, when the new plant is installed. No. 5 also has a new steel shaft-rockhouse, built in 1902, and is to be equipped the same as Nos. 3 and 4.

The Baltic lode is an exceptionally strong amygdaloid, ranging from 15′ to 60′ wide, and is so well mineralized that at most points it must be more or less thoroughly beaten away from wall to wall. The great width of the stopes has brought about the use of a walling system, by which waste rock is built into dry walls along the drifts, thus saving timbering, giving stronger walls than any timber could supply, and reducing cost of hoisting lean rock. A little copper ore is found as melaconite, in narrow fissure veins crossing the lode. These are too small to follow, but the ore mined in the stopes is saved in the milling, and carries 35% to 40% copper, as dressed. It smelts readily with the native copper mineral.

The Baltic lode was discovered in 1882, but while the showing in copper was good, work was abandoned at shallow depth because the drillhole was pitched at the wrong angle and speedily ran into the hanging wall. The property was again explored by Capt. W. A. Dunn, and the present company took over the mine in December, 1897, since when development has been continuous and most effective, the close of 1902 finding the Baltic, on its fifth birthday, among the 25 largest copper producers of the world.

The Baltic lode has a strike of N.63°E., from shafts 2 to 5. To the northeastward of No. 5 the strike and continuation of the lode are uncertain.

There is an extensive fault in this direction, though not yet reached by the north drifts from No. 5, and the lode is probably thrown some distance to the eastward. The dip of the lode averages about 73°—the sharpest of any developed cupriferous bed in the Lake district.

The compressor house is located between shafts 3 and 4 and is 36x58′, having concrete foundations and stone walls, with steel roof, housing a compressor with a capacity of 4,000 cubic feet of free air per minute, Adjoining is a boiler house of similar material, 49x76′, with wing 12x62′, having four Stirling water-tube boilers of 250 h. p. each, and a 140′ self-supporting steel smokestack. This boiler plant also furnishes steam for the hoist at No. 3. A coal trestle 360′ long, with storage capacity of 5,000 tons, adjoins the boiler house, and underneath the trestle is a 5x8′ concrete tunnel, through which coal is hauled by an endless cable in tramcars on a down-grade. A very complete electric plant for lighting the mine buildings and location started work in July, 1902. The mine structures include a combination machine shop and smithy, 50x132′, with stone walls and steel roof; carpenter shop 44x72′; a commodious office building put up in 1902; a miners' changing house, 30x90′, with hot and cold water, bathtubs, lockers, etc., and about 75 well-built and comfortable dwellings for employes. The mine is on the Painesdale branch of the Copper Range railroad, which transports the Baltic rock from mine to mill, and is also reached by a branch of the Atlantic railroad.

The Baltic stamp mill, at Redridge, on Lake Superior, half a mile west of the Atlantic mill, was begun in 1900 and went into commission in December, 1901, with one head. The mill proper is 175x195′ of structural steel on stone foundations very heavy throughout, the foundation alone costing nearly $90,000. There are four Nordberg stamps with 20x24″ cylinders, crushing about 500 tons each, daily. Foundations for the stamps are the most massive ever set, the use of timber cribbing having been dispensed with, and all castings and concrete made exceptionally heavy to withstand the terrific blows of the stamps. The anvil plates beneath the mortars weigh 90 tons each. Eight Wilfley concentrators are used in place of finisher jigs and slime-tables. A compound-condensing Corliss engine runs the four stamps and washing machinery. The discharge at the mill is 25′ above mean water datum of Lake Superior, and with the usual drop of one in ten provides for the wasting of many millions of tons of tailings by gravity alone. The mill is heated by a system designed and built by Coogan & Strothenke. Air is delivered through four blowers, being previously heated by passing over steam coils, radiation in the coils being insured by the vacuum system. Adjoining the mill is the boiler house, 55x90′, of steel frame on stone foundations, housing five 250-h. p. Stirling water-tube boilers. A Green fuel economizer is in use here. Instead of having a smokestack to induce draft for the boilers, a set of duplex fans, driven by the mill engine, has been installed. Behind the boiler house a storage yard has been built, holding about 25,000 tons of coal, for the joint use of the Baltic and Atlantic mills. Coal is brought to the boilers through tunnels, by gravity.

Water for both the Baltic and Atlantic mills is furnished by a dam across the mouth of the Salmon Trout river. An old dam built by the Atlantic in-

1894 was submerged to a depth of 20′ by the new dam, built jointly by the Atlantic and Baltic, at a cost of about $150,000. This new structure is the first of its kind in the world, being a steel gravity dam, so called because built of steel and anchored by its own weight, irrespective of the holding power of the rock at its bottom and sides. The plan was suggested by Mr. J. F. Jackson, of the Wisconsin Bridge & Iron Company, and the details were carefully inspected by Foster Crowell, of New York, an eminent hydraulic specialist, who acted as consulting engineer during construction. The dam was built by the Wisconsin Bridge & Iron Company and Prendergast & Clarkson, the completed work requiring about 1,000,000 pounds of steel and 8,000 cubic yards of concrete work. It impounds about 1,250,000,000 gallons of water and, estimating the flow ol the river at its minimum, can furnish water sufficient to wash 5,000 tons of rock daily, 300 days per annum. As the cost of pumping water at other mills in the district averages about 2 cents per ton of rock stamped, this figure represents the saving effected the Atlantic and Baltic companies by this dam.

The dam proper is in five sections, with a total length of 475′. The central, or deepest section, is 74′ high. The dam is anchored in a cement foundation of great strength. On either side are wings, the western being 200′ and the eastern being 350′ long. These wings are in comparatively shallow water, and are made with cement cores, buttressed by earth embankments, the concrete cores being built up from excavations in bed rock. The five sections of the dam proper are all of the same general design, the difference being that the central section is higher, as it is bottomed in the bed of the river, and has a wider and heavier concrete base with stronger steel bracing. Briefly described, the dam is of steel throughout, anchored in a base of concrete, with braces between the crest of the dam and the extreme foot of the cement base. The following description of the central part will give an idea of the general construction of all five sections. The concrete base is 62′ wide, built up from rock excavation. The resultant of all pressures gives a pressure of 2,626,000 pounds for each steel section of 8′ wide by 74′ high. The upper 50′ of the dam in this central section of 100′ is inclined at an angle of 45° from the water, which throws the point of overturning within the central third of the concrete base, allowing an ample margin of safety. The dam is made of plates of the best boiler steel, concave on the water side, 8x16′ in size by 3-8″ thick, riveted and caulked watertight, and supported by parallel inclined "I" beams 24″ deep for the full depth of 50′ below the crest of the dam. On the lower section the steel is of 3-16″ thickness, 8x16′ in size, concave, riveted and caulked, but resting directly against the concrete base. The "I" beams of the upper or main section are supported by heavy triangular frameworks of inclined steel columns and struts. The entire steel structure is anchored to a 2″ steel baseplate at the bottom of the concrete by a large number of 1½″, 2″ and 2½″ steel rods, of 15′ to 30′ in length.

Water is taken from the dam by three 38″ riveted steel pipes, from points about 20′ below the crest, one pipe being on the Atlantic and two on the Baltic side. A system of valves and waste weirs has been installed, but the structure is of such a nature that it could not be injured were water to flow continuously over its crest for an indefinite period. Surmounting this dam, and in it but not of it, is a railroad trestle, designed and built at the same time as the dam, but in nowise a portion of it. The center of the railroad track is 10′ down-stream from the crest of the dam, with the track 7′ above the crest. In the central sections the foundations for the feet of the trestle are all in the concrete work, but elsewhere the down-hill or northern piers for the trestle are below the concrete work, and are separately built. This trestle is used by the Copper Range railway in reaching the Baltic, Trimountain, Champion and Adventure mills, west of the Salmon Trout river.

The Baltic began production in August, 1899, using one leased stamp at the Atlantic mill. A second stamp was leased from the Atlantic one year later. The first stamp at the new Baltic mill began work Dec. 19, 1901; the second stamp started in February and the third in August, 1902. The fourth head also went into commission in 1902, but was put to work on rock from the Champion mine; this will soon be released for the use of the Baltic. There is no question of the ability of the mine to feed all four stamps with selected rock.

There are two remarkable features connected with the progress of the Baltic as a producer, these being the steadily increasing percentage of copper secured from the rock, and an equally steady increase in the monthly production. The mine has never taken a step backward, but from August, 1899, when the first product was secured, every month's output has been larger than that of the preceding month. The mine should begin 1903 with a monthly product crowding 600 tons of mineral, placing the Baltic fourth in output among Lake Superior mines and among the world's 20 largest copper producers. Meanwhile, the percentage of copper secured per ton of rock stamped increased from 17 pounds in 1899 to 19 pounds in 1900 and thence to 23 pounds in 1901, while about 25 pounds of ingot copper is being secured from every ton of rock stamped at the close of 1902. The Baltic is amply substantiating the favorable estimate of the mine made in the first annual issue of this work, and the critics that carped without understanding have ceased their ineffectual labors.

**BALVANERA MINING CO. MEXICO.**

Office: 11 Broadway, New York. Chas. W. White, secretary and treasurer. No returns secured.

**BARAGUNDA MINES. INDIA.**

At Baragunda, Hazaribagh, Bengal, India. Were operated 1887 to 1891, turning out about 1,000 tons copper, in those five years. Ore occurs as chalcopyrite running only 1% to 3% copper, in a gangue of micaceous schist. Matters were not improved by the necessity of carting all ore 24 miles to the smelter at Giridhi. Only possibility of making a paying mine would be in large operations, with smelter on the ground.

**SUCESION DE BARAZARTE. CHILE.**

Owns the Reventon mine, 400′ deep, and the Abundancia mine, 380′ deep, both opened 1830, at Paposa, Taltal, Chile. Properties idle at last accounts.

**BARRANCA COPPER CO. MEXICO.**

Office: 120 Liberty St., New York. Mine office: Barranca del Cobre, Chihuahua, Mexico. Schuyler Lawrence, manager. Operates La Purisima mine, producing copper, gold and silver. Main shaft, 750′, tunnel 2,100′. Water power; has 20 stamps, two 4′ Huntington mills and 60-ton smelter. Employs several hundred men when working. Closed, July, 1902, but supposed to have reopened. No direct returns secured.

**BASIN GOLD & COPPER MINING CO. MONTANA.**

E. R. Holden & Co., 20 Broad St., New York, fiscal agents. Organized under Montana laws, with capitalization $2,500,000, shares $5 par. Robert B. Smith, president; M. L. Hewett, vice-president and general manager; Chas. B. Lowenson, secretary; T. E. Collins, treasurer. Property, 14 patented claims, area 280 acres, near Basin, Jefferson Co., Mont. Property has considerable development but never has been able to procure any material production. Reduction plant is leased to United Copper Co.

**BASSETT MINES, LTD. ENGLAND.**

Offices and mines: Bassett Mines, Redruth, Cornwall, England. F. Oats, chairman; R. Rendle, secretary; W. James, mine manager. Capital, nominal, £100,000, but property is operated on the cost-book plan. Is primarily a tin mine, but produces a little copper. Is developed by shafts; has steam power and stamps.

**BATES MINING AND SMELTING CO. MASSACHUSETTS.**

Office: Gardner, Mass. Mine at Charlemont, Franklin Co., Mass. Employs 5 men, in development work. Organized 1902, under laws of Maine, with capitalization $200,000, shares $1 par, non-assessable. Wm. H. Bates, Jr., president and general manager; Anton Scholz, Jr., secretary; J. North, mining captain. Lands, about 75 acres, showing 3 fissure veins averaging 3′ width, ore assaying 16% copper and $10 gold per ton. Ores, chalcocite, bornite and chalcopyrite. One shallow shaft, one 60′ tunnel and an open cut. Company contemplates driving tunnel 500′, sinking shaft 350′ and adding a concentrator and power plant in 1903.

**BATTLE COPPER MINING CO. WYOMING.**

Office: Equitable Bldg., Denver, Colo. Mine office: Battle, Carbon Co., Wyo. Organized 1898, under laws of Colorado, with capitalization $1,500,000, shares $1 par. W. H. Baker, president; Phil. S. Delany, vice-president; J. C. Helm, secretary and treasurer; W. C. Leadbetter, general manager. Mining lands, 3 patented claims, area 54 acres, showing 6 contact veins with average estimated width 30′, length 2,000′ and estimated average value 11% copper and $4 to $40 gold per ton. Ore, sulphide; 13 shafts, 10′ to 213′. Steam power. Mine is on line of aerial tram to Encampment smelter.

**BATTLE LAKE COPPER EXPLORATION CO. WYOMING.**

Office: 25 East Pike's Peak Ave., Colorado Springs, Colo. No definite returns secured.

**BATTLE LAKE TUNNEL SITE MINING CO. WYOMING.**

Office: 1,323 Chamber of Commerce, Chicago, Ill. Mine office: Rambler, Carbon Co., Wyo. Employs 25 to 50 men. Organized 1900, under laws of Wyoming, with capitalization $2,500,000, shares $1 par, non-assessable. M. A. Cheney, president; J. W. Brooks, Jr., vice-president; F. P. Armbruster, secretary and treasurer; H. J. Stegemann, general manager; preceding officers, W. J. Ford, F. J. Lamberton, C. S. Tomlinson, J. M. Thomas, Jr., and W. J. Russell, directors; G. Allyn, mining engineer. Lands, 40 claims, 11 patented and 29 unpatented, area 800 acres, in Battle district of Carbon Co. Number ore bodies on claims not wholly known; 5 fissure veins averaging 4′ now being developed. Ores are carbonate, oxide and sulphide, estimated to average 20%; average of shipments to close of 1902 better than 47% copper. One shaft, 360′, 3 tunnels of 265′, 500′ and 895′. About one-half mile of underground openings; blocking out for stoping just begun. Equipment includes Ingersoll-Sergeant and Rand compressors, power drills, Cameron pumps, two 6x8′ hoists, boilers, etc. New work contemplated for 1903 is along lines of general development and company will continue sinking to determine the exact location, size and permanence of its ore bodies—a very wise plan for a new property.

**BATTLE LAKE & BATTLE CREEK MINING CO. WYOMING.**

Address: care of N. B. Noble, Rice Lake, Wis. Property, near Battle, Carbon Co., Wyo. No returns secured.

**BAUMANN COPPER CO. ARIZONA.**

Office: Prescott, Ariz. Organized under laws of Arizona, with capitalization $600,000, shares $1 par. H. P. Anewalt, president; Robert E. Morrison, vice-president; Jules Baumann, secretary and general manager; W. S. Goldsworthy, treasurer. Property, 25 claims, area about 500 acres, in the Agua Fria district, Yavapai Co., Arizona.

**BAXTER MINE. CALIFORNIA.**

A prospect at Redding, Shasta Co., Cal., near the Bully Hill mine of the Mt. Shasta Gold Mines Corporation. No returns secured.

**BAY HORSE COPPER MINING CO. WYOMING.**

At Riverside, Carbon Co., Wyo. W. G. Foss, superintendent. Was developing with small force at last accounts.

**BEAN COPPER CO. ARIZONA.**

At Gila Bend, Ariz. C. C. Bean, manager. Has copper-gold ores, opened by shaft; steam power and small force employed, at last accounts.

**BEAR MOUNTAIN MINING & DEVELOPMENT CO. WASHINGTON.**

At Colville, Stevens Co., Wash. C. G. Carruthers, superintendent. Was opening gold-silver-copper ores by tunnel, at last accounts.

**BEAR MOUNTAIN TUNNEL & MINING CO. COLORADO.**

Near Crystal, Gunnison Co., Colo. Geo. C. Eaton, superintendent. Copper-silver-gold ores opened by tunnel; water power utilized.

**BEARS' GULCH MINE. MONTANA.**

At Twin Bridges, Madison Co., Mont. Owned by Alex. Johnson; no returns secured.

**BEAVER CONSOLIDATED MINING CO. UTAH.**

Office: 23 Eagle Blk., Salt Lake City, Utah. Mine office: Milford, Beaver Co., Utah. Employs 15 men. Organized 1902, under laws of Utah, with capitalization $1,000,000, shares $1 par. J. J. Trenam, president and general manager; J. J. Corum, vice-president; B. L. Corum, secretary; E. H. Jacobs, treasurer. Directors are preceding officers, Z. C. Trask and F. Eberhardt; H. D. Trenam, superintendent. Lands, 10 claims, area 190 acres, showing fissure veins. Sulphide ore, taken from numerous shallow workings, assays 5% to 50% copper with considerable gold and silver values. Shafts of 50', 100', and 105'. Steam hoists, air compressors, etc. Company contemplates sinking shaft to depth of 500' and crosscutting, in 1903.

**BEAVER COPPER MINING CO. WYOMING.**

Address: Collins, Wyo. F. S. Dickinson, superintendent. Supposed to be developing with small force.

**BEAVER COPPER MINING CO. WYOMING.**

Office: Encampment, Wyo. Mine office: Downington, Carbon Co., Wyo. Employs 20 men. Organized under laws of Wyoming, with capitalization $1,000,000, shares $1 par. S. H. Scofield, president and general manager; L. W. Woodson, vice-president; E. H. Parkison, secretary and treasurer; W. H. Parkison, superintendent. Mining lands, 7 patented claims, area 120 acres, in the Encampment district, showing 3 fissure veins, 2 having average width of 40' and estimated length of 1,300', showing estimated values of 11.5% copper and $10 gold per ton, from oxide ores. Has 900' tunnel and 1,200' of underground openings. Estimated ore in sight, 18,000 tons. Steam plant, air compressors and drills. Will continue development work in 1903.

**BEAVER LAKE COPPER CO. PENNSYLVANIA.**

A prospect near Bloomsburg, Columbia Co., Pa. Twelve men working on tunnel, at last accounts. Ore said to assay 17%. Local paper states that "a large smelter" is to be built at a cost of $1,500, but neglects to say how extensive a plant can be secured for this sum.

**BECKLER RIVER CLAIMS. WASHINGTON.**

Owned by Abner Giffin, et al, 22 Sullivan Blk., Seattle, Wash. Property, 15 claims, at Skykomish, Snohomish Co., Wash. Opened by tunnel; said to have a large ore body assaying well in copper, gold and silver; no returns secured for 1902.

**BEDE METAL & CHEMICAL CO. SPAIN AND NORWAY.**

Offices: Newcastle-on-Tyne, England; mines, in province of Huelva, Spain, and in the Roros district of Norway. Capt. Sir Andrew Noble, president. Operates works at Newcastle and smelters at Hebburn-on-Tyne, England. Is primarily a manufacturer of acid and other chemical products, but secures no inconsiderable amount of copper from the cinders of Spanish and Norwegian cupriferous pyrites. Las Herrerias mines, at Puebla de Guzman, Huelva, Spain, are leased by this company. The production of refined copper has not been obtained, but is probably several thousand long tons yearly. See Las Herrerias.

**BELENE COPPER CO. MEXICO.**

Office: 160 Washington St., Chicago, Ill. Mine Office: El Copete, Sonoro Mex. Employs 100 men. Organized 1901, under laws of Arizona, with capitalization $5,000,000, shares $5 par. Registered and protocolized in Mexico, June 25, 1902. S. E. Hostetter, president; James Baynes, secretary and treasurer; J. J. Hardwick, general manager; Louis Killeen, assistant manager; J. Faulds, superintendent. Lands, 7 patented claims, area 405 acres, in the Ures district of Sonora. Two lenses, carrying sulphide ores, are being developed Company will not estimate size of ore bodies, but they are of great extent, giving average assays of 12% copper, $10 gold and 8 oz. silver per ton. Has 6 shafts, 40′ to 310,′ and 3 tunnels, 40′ to 200′. Horse power equipment. Smelter of Copete Mining Co. is on lands of the Belene and does custom work for latter. Company will continue development work, install steam and electric plant and may build 200-ton smelter in 1903, latter installation being held awaiting development showing nature of ore below water line. Company estimates output for 1903 at 3,600,000 pounds. Property is regarded as one of much promise.

**SOCIETE ANONYME BELGE POUR LA RECHERCHE ET L'EXPLORATION DES MINERAIS. ITALY.**

A Belgian company of this name is operating a pyrite mine at Massa Maritima, Italy. No returns secured.

**BELL MARE COPPER MINING & SMELTING CO. NEVADA.**

Merged in the Nevada Bell Copper Mining & Reduction Co.

**BELLE MARSH MINE. IDAHO.**

A prospect near Pocatello, Idaho, said to be valuable, regarding which no returns have been secured.

**BELLE OF GRANITE MINE. COLORADO.**

At Granite, Chaffee Co., Colo. B. H. Pelton, superintendent. Has gold-silver-copper ores; has steam plant and was working 30 men at last accounts.

**BELMONT MINING CO. COLORADO.**

At Winfield, Chaffee Co., Colo. Jas. Beuell, superintendent. Ores carry gold, silver and copper; prospecting with small force at last accounts.

**BELMONT MINING CO. MONTANA.**

United Copper Co. owns 95% of total stock issue of 1,000,000 shares.

**BELT MINES. MICHIGAN.**

Located in Ontonagon county, Michigan, near main line of Copper Range Railroad. Owned by John H. Rice, et al, Houghton, Mich. First mining work done in 1848. The Belt Mines Co., Ltd., an English corporation, took over the mines in 1882, and by incompetence and bad management lost about £250,000 in three years, without securing even a half-mile of underground openings to show for the expenditure. A little exploratory work was done on the property in 1901 but was discontinued because of the low price of copper. Fully described in the 1902 edition of this work.

**BEN FRANKLIN GOLD MINING CO. WASHINGTON.**

Near Bossburg, Stevens Co., Wash. A. A. Anderson, superintendent; was prospecting gold-copper ore bodies at last accounts.

**BEN HARRISON GOLD & COPPER MINING & MILLING CO. UTAH.**

Office: 23 Eagle Blk., Salt Lake City, Utah. Mine office: Milford, Beaver Co., Utah. Employs 16 men. Organized 1897, under laws of Utah, with capitalization $500,000, shares $1 par. F. Eberhardt, president; J. J. Trenam vice-president and general manager; B. L. Corum, secretary; E. H. Jacobs, treasurer; H. D. Trenam, superintendent. Lands, 11 unpatented claims, area 195 acres, showing 2 fissure veins, with estimated average value 5% copper, $7 gold, 10 oz. silver per ton. Ore, sulphide. Has 300′ shaft. Steam power; will continue development work in 1903.

**BEN HUR COPPER MINING CO. WYOMING.**

Office: 407-145 LaSalle St., Chicago, Ill. Mine office: Riverside, Carbon Co., Wyo. Employs 6 men. Organized 1902. under laws of Wyoming, with capitalization $1,000,000, shares $1 par. Chas. G. Mason, president; W. S. Smith, Jr., vice-president; John H. Stoddard, secretary; Clifford M. Miller, treasurer; N. C. Bowen, general manager. Lands, 4 claims, one patented, area 60 acres, showing 3 fissure veins carrying sulphide ores, one vein having average width of 40′, developed by short tunnel. Will continue tunnel 300′ in 1903.

**BENTON COPPER MINES. CALIFORNIA.**

Thirty-six claims in the White Mountains, 8 miles east of Benton, Mono Co., Cal. Some development work has been done; no returns secured.

**JOŜE BERNARDINO. MEXICO.**

Stated by the Mexican government to be operating a copper mine at Nombre de Dios, Durango, Mexico, but further details unobtainable.

**NOEL BERTHINI. BOLIVIA.**

Office and mines: Coro Coro, La Paz, Bolivia. The second largest producer of Bolivia. Product is crude native copper, obtained from conglomerates. Output, 371 tons in 1897; said by American consul at La Paz to be about 1,200 tons of mineral running 90% copper, for 1902.

**BESA Y COMPANIA. CHILE.**

Operate mines in the department of Chañaral, Chile, shipping product as matte. Annual output estimated as equivalent to 1,300 tons.

**BESSEMER IRON ASSOCIATION. NEW MEXICO.**

At Hanover, Donna Ana Co., N. M. A. E. Dawson, lessee. This company owns the Anson S. copper mine, regarding whieh no particulars have been secured.

**BESSHI MINE. JAPAN.**

Address: care of Kichizayemon Sumitomo, Osaka, Japan. This mine, the second largest in the island empire, is located in the province of Iyo, Island of Shikoku, Japan. It was opened in 1690 by the Sumitomo family, in whose hands it still remains. The annual production is 4,000 to 5,000 long tons and the property is equipped with modern machinery, including an excellent smelter. The management is noted for its progressiveness.

**BEST CHANCE CLAIM. WASHINGTON.**

Letter addressed to Berlin, King Co., Wash., returned unclaimed. Was driving a prospecting tunnel with H. Bulwer, superintendent, and small force, at last accounts.

**BETTS COVE MINE. NEWFOUNDLAND.**

At Betts Cove, Nfld. Opened 1874 and closed 1884. Reopened by an adit in 1900, but thought to be idle again.

**BEULAH COPPER CO., WYOMING.**

Office: 113 Devonshire St., Boston, Mass. Mine office: Battle, Carbon Co., Wyo. Capitalized at $1,000,000, shares $1 par. Frank S. Morrison, president; Danl. S. Pratt, treasurer; J. F. Leadbetter, general manager. Lands, 13 claims, area about 250 acres. Has 800′ tunnel which should soon strike a large vein outcropping at surface. No direct returns secured from the company.

**BIG COTTONWOOD CONSOLIDATED GOLD & COPPER MINING CO. UTAH.**

Office: Salt Lake City, Utah. Mine office: Brighton, Utah. Nicholas Treweek, president; Oliver Hagen, vice-president; Wm. I. Goodrich, treasurer; Jos. G. Fariss, secretary; Will L. Treweek, general manager. Was driving tunnel at last accounts; said to have 40′ vein of high-grade ore. Property considered promising.

**BIG CREEK COPPER MINING CO. WYOMING.**

Office: Encampment, Carbon Co., Wyo. L. D. Godshall, superintendent. Working small force on development.

**BIG INDEX GOLD & COPPER MINING CO. WASHINGTON.**

Office: Seattle, Wash. Owns a property 4 miles from Baring, Wash. Said to have a large vein of copper ore; no particulars secured.

**BIG SHOW SILVER & COPPER MINING CO. MONTANA.**

Mine office: Twin Bridges, Madison Co., Mont. Organized under Arizona laws, with capitalization $1,500,000, shares $1 par. Lands, 4 claims, also option on a water power and millsite. Shows good assays; employs small force; ores carry gold, silver and copper.

**BIG YANK MINING & MILLING CO. OREGON.**

Operated a gold-copper property near Galice, Josephine Co., Oregon, with J. C. Mattison as superintendent, at last accounts.

**BINGHAM CONSOLIDATED MINING & SMELTING CO. UTAH.**

Office: 700 McCornick Bldg., Salt Lake City, Utah. Eastern office: 60 State St., Boston, Mass. Mine office: Bingham Canyon, Salt Lake Co., Utah. Employs 500 men. Organized 1901, under laws of Maine, with capitalization $1,000,000, shares $50 par, non-assessable and full paid; is a reorganization of the Bingham Copper & Gold Co. E. L. White, president; Clarence McCornick, vice-president; H. W. Wesson, secretary; O. E. Weller, treasurer. Directors are preceding officers, J. A. Coram, Wm. F. Hammett, John W. Weeks, T. L. Trull, P. L. Kimberly and Wm. Bailey. Duncan McVichie, general manager; R. W. Rodgers, general mining superintendent; W. H. Nutting, smelter superintendent; H. G. Heffron, purchasing agent and ore buyer.

The principal mining property is located in the Bingham or West Mountain district of Salt Lake Co., and consists of the Dalton & Lark, Antelope, Brooklyn, Miners' Dream, Commercial and some 25 adjoining claims, also the old Bingham group of mines. Company also owns an interest of 231,500 shares in the Tesora mine of the Tintic district. Property in Bingham Canyon is about 6,500′ above sea level and 1,000′ above the valley. Ore is chalcopyrite, low in copper, averaging 2½% to 3%, but carrying gold and silver values of $2 to $3 per ton. Ore is ferruginous and free smelting. Company is producing considerable galena, from the Commercial mine, which is smelted by the American Smelting & Refining Co.; is understood that Bingham Co. contemplates installation of a lead smelter. The Dalton & Lark tunnel is about 5,000′ in length at close of 1902 and is to be extended to about 7,000′ for the drainage of the properties and also for development and transportation of ores. Shafts are 850′ and 1,300′; 4 tunnels aggregate 9,530′. Has an electric railway for tramming ores.

The silicious copper ores of Utah demand a fluxing agent, such as is found in the ferruginous sulphides of the Bingham. This company purchases considerable silicious copper ore from other mines.

The smelter is at Bingham Junction, 13 miles from the mine; has 1,000-h. p. Rarig blowing engine; Stirling boilers; automatic stokers, etc. The pyritic system of smelting is used. Smelter has aggregate capacity of 600 tons daily. The Bingham iron-sulphide ores are smelted to a low-grade matte in the blast furnaces, and this matte is resmelted with silicious sulphides, producing a 30% to 35% matte. Product is turned out as blister copper, average 98.35%, and is electrolytically refined in the east, for saving the gold and silver values. Smelter was handling about 500 tons daily at close of 1902. Construction of smelter was begun April 16, 1900, and first furnace blown in Jan. 31, 1901. Building is of steel frame, with iron sides and roof, steel and cement floors, on stone foundations, 150x400′ in size, with 375′ dust chamber, and has four 200-ton water-jacket blast furnaces, 42x172″. Converter plant, installed 1902, has six 10-ton converters in 2 stands, and 100-ton briquetting machine. Power for smelter is furnished by Utah Light & Power Co.

Production of copper was 1,041,801 pounds in 1901 and about 10,000,000 pounds in 1902. Company estimates 1903 production at 13,000,000 pounds. Property should pay a dividend in 1903.

**BINGHAM COPPER BOY MINING CO. UTAH.**

Office: Salt Lake City, Utah. C. W. Morse, president; A. Hanauer, Jr., vice-president; J. H. Hurd, secretary; J. B. Taylor, superintendent. Organized under laws of Utah, with capitalization $1,500,000, shares $1 par. Lands, 11 claims, area about 160 acres, adjoining Highland Boy mine of Utah Consolidated Co. Said to be a property of merit, but no returns secured.

**BINGHAM & EASTERN MINING CO. UTAH.**

Office: New Haven, Conn. Property includes claims near Bingham Canyon, Salt Lake Co., Utah; no returns secured and property idle at last accounts.

**BINGHAM-NEW HAVEN COPPER & GOLD MINING CO. UTAH.**

Office: New Haven, Conn. Lewis E. Stoddard, president; D. W. Farnham, secretary and treasurer; F. E. Benedict, manager. Property, about 150 acres, adjoins the Highland Boy mine in Bingham Canyon, Salt Lake Co., Utah, and includes the Zelnora mine, which has produced considerable ore. Ores carry copper, gold, silver and lead. Development is by tunnel; property considered valuable.

**BINGHAM & SALT LAKE MINING CO. UTAH.**

Office: 64 East Second St., Salt Lake City, Utah. No returns secured.

**BIRTHDAY COPPER SYNDICATE. TASMANIA.**

Has promising copper ores near the coast, about 20 miles from Macquarie Heads, Tasmania. Owns 510 acres of mineral lands.

**BISBEE CONSOLIDATED MINING CO. ARIZONA.**

Mine office: Bisbee, Cochise Co., Ariz. Has considerable tract of land; shaft, about 100′, from which some good ore was secured late in 1902.

**BISBEE BELLE COPPER CO. ARIZONA.**

Office: 401 Laughlin Bldg., Los Angeles, Cal.; also has office at 306-147 Milk St., Boston, Mass. Mine office: Bisbee, Cochise Co., Ariz. Capitalization $1,250,000. Geo. M. Case, president; J. B. Monlux, vice-president; Geo. Van Derwerker, secretary. Lands, 25 claims, in Warren district of Cochise Co. Employs 10 to 15 men. Has 4 shafts, deepest 150′, at beginning of 1902. Shipped a little ore to Val Verde smelter, near Prescott, in 1902. Officers are men of good standing, and property well spoken of.

**BISBEE WEST COPPER MINING CO. ARIZONA.**

Office: Los Angeles, Cal. Mine office: Bisbee, Cochise Co., Ariz. Organized 1899, under Arizona laws, with capitalization $4,000,000, shares $1 par. A. S. Robbins, president; F. L. Dwight, superintendent. Lands, about 440 acres, near Copper Glance mine. Developed by shafts and tunnels. Said to have a considerable body of ore, assaying 5% to 10%. Has had considerable trouble from large underground body of water, which may become valuable, as water is scarce in the district and company has franchise to supply water to the city of Bisbee. New machinery plant installed late in 1902. Company is working along honest lines, with fair prospects.

**BISMARCK-NUGGET GULCH CONSOLIDATED MINING CO. MONTANA.**

Office: Stock Exchange Bldg., Chicago, Ill. Said to have 17 copper claims and 14 gold claims, somewhere in Montana, but no returns secured from company.

**BITTER ROOT COPPER MINING CO. MONTANA.**

Office: 1,030 Guaranty Loan Bldg., Minneapolis, Minn. Mine office: Saltese, Missoula Co., Mont. Employs 40 men in development work. Organized 1902, under laws of Arizona, with capitalization $5,000,000, shares $1 par, non-assessable. L. G. Beebe, president; J. H. Quinn, vice-president; L. E. Cross, secretary; S. S. Secor, treasurer and general manager; H. J. Welsh, mining engineer; Jerry Cooney, mining captain. Lands, 14 claims, 2 patented, area 240 acres, also 10-acre millsite and 20-acre smelter site, in the St. Regis district of Missoula Co. Two fissure veins being developed; average width returned by company as 25′; estimated values, 28% copper, $10 gold and 6 oz. silver per ton. Ores, oxide and sulphide. Has 4 shafts, deepest 200′, and 900′ tunnel, with 1,600′ of underground openings; company states that 120,000 tons of ore are blocked out for stoping. Has steam power, hoists, etc. Northern Pacific R. R., 5 miles distant. Company contemplates deepening shafts and drifting, also installing electric plant and aerial tramway and building a matting furnace at Saltese in 1903.

**BLACK BAY COPPER MINING COMPANY. ONTARIO.**

A company by this name is sinking a shaft, somewhere in the Thunder Bay district of Ontario, on the northern shore of Lake Superior. Shaft is of little depth, in an amygdaloid carrying native copper.

**BLACKBIRD COPPER & GOLD MINING CO. UTAH & IDAHO.**

Office: 519 Dooly Bldg., Salt Lake City, Utah. Lands, near Salmon, Lemhi Co., Idaho, and Frisco, Beaver Co., Utah. Geo. S. Fitzwater, superintendent of Idaho property. Beaver county property consists of Copper Gulch group of 103 unpatented claims, near Frisco. At last accounts company contemplated setting off a new corporation to work the Utah property. Is sinking a large shaft, to go down 1,000′. Steam power; employed small force at last accounts.

**BLACK CHIEF MINE. ARIZONA.**

At Dewey, Yavapai Co., Ariz. Timothy Fell, owner. Was sinking shaft with small force at last accounts.

**BLACK DIAMOND COPPER MINING CO. ARIZONA.**

Office: 99 John St., New York. Mine office: Pearce, Cochise Co., Ariz. Organized 1898, under laws of West Virginia, with capitalization $2,000,000, shares $5 par. Frank H. Crockard, president; Julian G. Herne, vice-president; N. O. Bagge, treasurer and general manager; Jas. A. McBain, secretary; G. M. Henry, superintendent. Lands, about 400 acres, in the Dragoon Mountains, Cochise Co.; 18 miles from nearest railroad. Company is in good financial condition and has no indebtedness. Built a 200-ton smelter in 1902, connected with mine by 1½ mile aerial tram. Is expected smelter will be blown in early in 1903. Ores occur as contact veins between limestone and porphyry, veins ranging 120′ to 125′ wide, carrying values in chutes ranging from 1′ to 20′ in width. Surface ores are carbonates, changing at depth to bornite and chalcopyrite, averaging perhaps 5% to 6% copper, with good silver values and a little gold. Property has about two miles of underground openings and is developed mainly by tunnels; has been vigorously developed and expenditures have not been stinted. It is to be hoped that the large development work secured underground will be sufficient to feed the new smelter.

**BLACK DIAMOND TUNNEL CO. BRITISH COLUMBIA.**

Office: 604 Land Title Bldg., Philadelphia, Pa. Property, according to advertisement of the company, somewhere in the Ainsworth camp of British Columbia. Maxwell Stevenson, president. Company advertises gorgeously, but fails to furnish specific returns.

**BLACKFOOT COPPER CO.**

Address unknown. Property ditto. Stock was sold in the east by Morrill Smith & Co., 7 Water St., Boston, Mass. No returns secured; stock presumably worthless.

**BLACKFOOT MINING & MILLING CO. WYOMING.**

Mine office: Battle, Carbon Co., Wyo. H. M. Shields, superintendent. No returns secured.

**BLACK HILLS COPPER CO. SOUTH DAKOTA.**

Office: Benton Harbor, Mich. Mine office: Rochford, Pennington Co., So. Dak. Organized under laws of South Dakota, with capitalization $2,000,000, shares $1 par. John E. Barnes, president; Geo. D. Thresher, secretary. Lands, 210 acres, in Pennington Co. Mine opened by slope-tunnel about 800′ long, from which a crosscut driven 200′ penetrated a large ore body in October, 1902. Vein wide, ranging 50′ and upwards, but low grade, assaying 1½% to 3% as a rule, although assays up to 5% have been secured. Ore carries a little gold, silver, nickel and cobalt. Company seems conservatively and honestly managed.

**BLACK HILLS COPPER CO., LTD. ARIZONA.**

Office: 224 Douglas Bldg., Los Angeles, Cal. Mine office: Jerome, Yavapai Co., Ariz. Employs 10 to 20 men. Organized 1899, under laws of Arizona, with capitalization $3,000,000, shares $1 par, non-assessable. R. A. Thomas, president; Thos. E. Metcalf, vice-president; W. W. Thomas, secretary; W. B. Simmons, assistant secretary; preceding officers, Thomas B. Oliver and Francis L. Robbins, directors. Management in hands of Western Mining Development Company. W. B. Shilling, mining engineer. Lands, 15 claims, 6 patented, with area approximately 300 acres, in the Verde and Black Hills districts of Yavapai Co., Ariz. Has incline shaft 200′ and tunnel 217′ with about 1,500′ of underground openings. Gasoline and steam hoists, air compressors, power drills, etc. Property, 2 miles from United Verde & Pacific R. R.

**BLACK HILLS & DULUTH COPPER MINING CO. SOUTH DAKOTA.**

Office and mine: Custer, Pennington Co., S. D. Capitalization $3,000,000, shares $1 par. F. A. Towner, president; M. J. Bailey, secretary. Lands, 340 acres. Has 2 shallow shafts, showing carbonate and sulphide ores. Was exploring with diamond drill at last accounts.

**BLACK MARIA & SILVER BELLE MINES. IDAHO.**

Mine office: Mineral, Washington Co., Idaho. A. J. Crook, superintendent. Has copper-silver ores, developed by tunnel and shaft; has steam power and 20-ton smelter, with about 50 men employed.

**BLACK PRINCE COPPER CO. ARIZONA.**

Owns 8 or 9 claims in the northwest portion of the Dragoon Mountains, Cochise Co., Ariz. Cannot be learned that the company is doing any mining work.

**BLACK ROCK GOLD & COPPER CO. ARIZONA.**

Property about 4 miles from Jerome, Yavapai Co., Ariz. No returns secured.

**BLACK TIGER COPPER MINING CO.** **WYOMING.**

Office and mine: Encampment, Carbon Co., Wyo. Company promoted by Federal Security Co., 277 Dearborn St., Chicago, Ill. Capitalization $1,000,000. Fennimore Chatterton, president; B. McCaffrey, general manager. Lands, about 103 acres. Was developing actively at last accounts. Property thought to be valuable, but no returns secured.

**BLACK TIGER MINE.** **COLORADO.**

At Redcliff, Eagle Co., Colo. J. F. Fleming, superintendent. Was developing gold-silver-copper ores by tunnel, with small force, at last accounts.

**BLACK WARRIOR COPPER CO., AMALGAMATED.** **ARIZONA.**

Office: 1420 Chestnut St., Philadelphia, Pa. Mine office: Black Warrior, Gila Co., Ariz. Jas. A. Fleming, president and general manager; Ernest L. Tustin, secretary; E. H. Benson, superintendent. Capitalization increased, Nov., 1902, to $2,500,000, shares $10 par, to provide funds for completion of reduction plant and continuance of development. Property idle greater part of 1902, owing to excessive freight rates, which have been reduced. Lands, upwards of 1,500 acres. Development begun 1895; has extensive underground openings and large ore bodies opened for stoping. Equipment includes a large leaching plant for reducing low-grade silicious oxide ores, of which there are enormous bodies. A blast furnace is also to be added for handling ores not adapted to leaching.

**BLANCHE COPPER MINING CO.** **WYOMING.**

Office: 1018 N. Y. Life Bldg., Omaha, Neb. Mine office; Encampment, Carbon Co., Wyo. Employs 5 men. Organized 1902, under laws of Wyoming, with capitalization $1,000,000, shares $1 par. H. E. Owen, president; John R. Wertz, vice-president; Jas. H. Kyner, secretary; D. M. Owen, treasurer; A. H. Crow, general manager; Chas. McGee, superintendent. Lands, 5 unpatented claims, area 103 acres, in Douglass Creek district of Albany Co., showing 2 fissure veins carrying high-grade sulphides, with average width 5′. Ores also carry gold and platinum. Two shafts, 30′ and 75′. Will continue development work and management contemplates installation of complete mining plant. Property adjoins New Rambler and has same character of ore.

**BLANCHE MINE.** **NEW MEXICO.**

At Organ, Donna Ana Co., N. M. W. H. Mackay, Jr., owner; B. O. Mills, superintendent. Was working 15 men at last accounts.

**BLAND MINE.** **NEW MEXICO.**

Near Patagonia, Santa Cruz Co., Ariz. Powers, Clark & Heck, owners. Was developing copper-silver-gold ores by tunnel, with small force, at last accounts.

**BLAYNEY MINING & SMELTING CO.** **AUSTRALIA.**

In the Blayney division of New South Wales. Has 50 acres of freehold. Smelter has 2 water-jacket furnaces. Main shaft, 390′ deep. In 1901 produced 418 tons copper from 18,666 tons ore smelted. Property idle at last accounts.

**BLINMAN MINE.** **AUSTRALIA.**

Address: care of J. M. Higgins, with T. Rollison, 105 Queen St., Melbourne, Australia. Lands, in Flinders Range, South Australia, about 270 miles north of Adelaide. Opened 1862, reopened circa 1899. Deepest shaft, 450′. Ore averages 8% copper, and is brought up to 23% for shipment, hand-picked ores ranging 30% to 40%. Country arid; much trouble experienced from drought, causing insufficient water supply for continuous operations. Annual capacity, about 1,250,000 pounds refined copper.

**BLUE ACRE COPPER COMPANY.** **UTAH.**

Office: 409 Dooly Blk., Salt Lake City, Utah. Branch offices: Boston and St. Louis. Mine office: Milford, Beaver Co., Utah. Capitalization, $600,000, shares $1 par. Henry M. Crowther, president and general manager; Wallace W. Wait, vice-president and treasurer. Lands, 320 acres, just west of the O. K. mine of the Majestic Co. Assays of surface ores give 12% to 26% copper. Company is sinking 3 shafts. Management well spoken of and property thought to be of promise.

**BLUE BELL COPPER MINING CO.**

Office: 36 Swiss St., Cleveland, Ohio. No replies to requests for information.

**BLUEBELL MINE.** **ARIZONA.**

At Johnson, Cochise Co., Ariz. T. K. Mitchell, superintendent. Was doing development work with small force at last accounts.

**BLUE BELL MINING CO.** **CALIFORNIA.**

Near Hosslekuss's, Plumas Co., Cal. J. J. Sullivan, superintendent, Quincy, Cal. Property was being developed by tunnel at last accounts.

**BLUE BIRD COPPER-GOLD MINING CO.** **UTAH.**

M. J. True, secretary and general manager, Salt Lake City, Utah. Property, short distance north of Hickory group of Majestic Co. Has 275′ shaft on Copper King claim. Company arranging in December, 1902, to resume work with a strong force. Property regarded as promising.

**BLUE BIRD MINING & SMELTING CO.** **WASHINGTON.**

Near Darrington, Snohomish Co., Wash. Thos. Parks, superintendent. Was developing by tunnel at last accounts.

**BLUE CREEK COPPER MINING CO.** **WASHINGTON.**

Office: 15 Jamieson Blk., Spokane, Wash. Idle. Capitalization $75,000, shares 5 cents par. Wm. Watson, president; Jere J. Brown, secretary and treasurer; Wm. Watson, Wm. H. Smith, Chas. H. Montgomery, Edgar S. Babb and Jere J. Brown, directors; F. S. Sherwood, general manager. Lands, 3 unpatented claims, area 60 acres, in the Chewelah district of Stevens Co., Wash. Five-foot fissure vein assays 9% copper and $1.50 each in gold and silver per ton. Ores, sulphide; 5 shafts, deepest 90′; one tunnel, 170′; 326′ of underground openings.

**BLUE HILL COPPER MINES.** **MAINE.**

At Blue Hill, Maine. Were worked for copper without success, and have been idle for many years.

**BLUE JACKET CONSOLIDATED COPPER CO.** **IDAHO.**

Office: 20 Broad St., New York. Mine office: Decorah, Washington Co., Idaho. Organized 1901, under West Virginia laws, with capitalization $1,000,000. Jos. H. Swift, president: Geo. F. Shaver, secretary; F. J. French, manager, at last accounts. Property, 295 acres in Seven Devils district. Supposed to have 30-ton smelter. No returns secured in response to repeated requests.

**BLUE JACKET MINE.** **IDAHO.**

At White Bird, Idaho Co., Idaho. Owned by Morton & Johnston, Lucille, Idaho. Operated under bond by Frank E. Johnesse. Lands, 4 unpatented claims, area 75 acres, showing 2 contact veins of great width, assaying 4% copper, $4 gold and 7 oz. silver per ton, from oxide ores near surface and sulphides at depth. Shafts 100′ to 300′ deep; 1,000′ underground openings. Gasoline power; operator will resume work March 1, 1903, to tap vein at depth of 500′.

**BLUE JAY MINE.** **NEVADA.**

At Yerington, Lyon Co., Nev. A. Pugh, superintendent; developing by shafts and tunnels, with steam power and about 20 men, at last accounts.

**BLUE JAY MINING CO.** **CALIFORNIA.**

At Letcher, Fresno Co., Cal. N. Phillips, superintendent; was working about 10 men at last accounts.

**BLUE LAKE GOLD & COPPER MINING, SMELTING & POWER CO.** **WASHINGTON.**

Office: Milwaukee, Wis. C. T. McElroy, general manager. Owns 20 claims on Goat Mountain, midway between Loomis and Conconully, Wash. About 5,000 tons of ore, assaying 3% to 49% copper and $3 to $11 gold per ton, have been raised from 6 veins, ranging 1′ to 3′ wide.

**BLUE LEDGE GROUP.** **CALIFORNIA.**

Owned by D. G. Adams, et al, Joe Creek, Cal. Property, 27 claims, unpatented, with area of 500 acres, in the Elliott Creek district of Siskiyou Co., Cal. Works 6 men, in development. Opening a lense 40′ wide, other dimensions unknown, assaying 4% copper and 8 oz. silver per ton. Ores, sulphide, with a little native copper. One shaft and 3 tunnels. Owners will continue development work in 1903.

**BLUE WING COPPER CO.** **NORTH CAROLINA.**

Was operating near Baker City, Granville Co., N. C., several years ago. No returns secured.

**BOBTAIL MINES CO.** **ARIZONA.**

Office: Minneapolis, Minn. F. D. Adams, superintendent. Lands, 20 claims near Globe, Gila Co., Ariz. No returns secured.

**BOCCHEGIANO MINE.** **ITALY.**

Near Massa Maritima, Grosseto, Italy. One of the oldest and most important mines of this district. See Montecatini.

**BOGOSLOVSKI GROUP.** **RUSSIA.**

Owned by Baron K. M. Keldt von Turgensburg, Perm, Russia. Mines are at Bogoslov, government of Perm, Russia. There are three mines in the group, which constitute one of the largest copper producers of the empire, the output for 1899 having been 72,961 poods. No later figures are available.

**COMPAGNIE DU BOLEO. MEXICO.**

Office: Rue de Provence, 56, Paris, France. American office: 614 Sansome St., San Francisco, Cal. Mine office: Santa Rosalia, Baja California, Mex. Employs about 3,500 men. Is rumored at close of 1902 that company will employ 3,000 Chinamen to work the mine. Capitalization 12,000,000 francs; net earnings for 1900, about 6,300,000 francs; expenditures for 1901 were 1,744,235 francs for improvements; 208,844 francs set aside for depreciation and 1,191,925 francs set aside for amortization and reserves, leaving net for the year 1,206,302 francs, from which dividends of 20 francs were paid on ordinary shares and 15.58 francs on founder's shares. Property is supposed to be controlled by the French house of Rothschild. Chas. La Fargue, general manager. Paris; W. W. Rose, general superintendent at mines.

The ore occurs in a formation of Tertiary conglomerates, sandstones and tufas, the cupriferous tufas overlying conglomerates of eruptive rock pebbles and being surmounted by argillaceous tufas, all traversed by fissures. Many varieties of ore are found, including cuprite, tenorite, atacamite, azurite, malachite, crednerite and chrysocolla. There are 3 cupriferous beds, in the second of which the ore occurs as oxides and carbonates, in concretions like oölites, these being known locally as boleos. The third copper-bearing bed is partly below the water line, and in addition to the ores already enumerated carries chalcocite and covellite, the richest sulphides. Ore is found in the tufas, disseminated and in thin, irregular veins, with marked concentration toward the bottom, where the ore forms compact beds of 6″ to 1′. The smelter returns averaged 4.29% in 1900 and 3.95% in 1901. Ore is hand-sorted and machine-briquetted, at a cost of only 20 cents per ton, the argillaceous gangue serving as a natural binder. Mines of the company are the Providencia, Puegatorio, Solidad and others.

The mine has complete steam and electric plants, including electric locomotives. Water is obtained by condensation from the sea, the condensing plant being of 1,500 h. p. capacity, with four powerful pumps, and supplying water for potable use as well as for the needs of the mine and smelter.

The smelting plant was rebuilt and thoroughly modernized 1900–1901, and now has 7 reverberatory furnaces, two of which are of 140 tons daily capacity each. The ore is brought to a 65% matte, then blown up to black copper and sent to the United States for refining. Coal is imported mainly from England and Germany. The town of Santa Rosalia has a population of 7,000, dependent on the mine. The climate is tropical and the country extremely arid. Production for 1900 was 10,217 metric tons, for 1901 was 10,596 tons and for 1902 about 10,000 tons.

**BOLINAS COPPER MINING CO. CALIFORNIA.**

Office: 253 Spear St., San Francisco, Cal. T. P. H. Whitelaw, president and manager. Owns copper property showing 9 perpendicular veins, 6″ to 2′ wide, in serpentine, 4 miles northeast of Bolinas Bay, Marin Co., Cal. Considerable development work has been done. Ore on dumps said to carry 5% to 10% copper. Has considerable equipment, including concentrator. Idle at last accounts and company refuses to furnish any statement.

**BOLIVIAN CO. BOLIVIA.**

Organized, circa 1901, by Sir Martin Conway. Holds important mining concessions from the Bolivian government on the basis of royalty of one-third net profits. Has concession of 10,000 square miles between the Andes and head-waters of the Amazon.

**BOMPA SYNDICATE. AUSTRALIA.**

Is exploring and developing a copper mine at Glassford Creek, Gladstone district, Queensland. A railroad is very badly needed.

**BONANZA GOLD & COPPER MINING CO., LTD. BRITISH COLUMBIA.**

At Grand Forks, Yale & Cariboo district, B. C. F. Knight, superintendent; has gold-silver-copper ores; was prospecting with small force at last accounts.

**BONANZA MINING CO. WASHINGTON.**

At Index, Snohomish Co., Wash. P. Chioda, superintendent; was opening copper-gold ores by tunnel, with small force, at last accounts.

**BONANZA QUEEN GROUP. WASHINGTON.**

At Silverton, Wash. A. Sutherland, manager. Eight claims with 4 veins; values chiefly gold and copper. About 1,200′ of development work done.

**BONNIE BELLE MINING & MILLING CO. WYOMING.**

Said to have had 2 claims near the Ferris-Haggerty mine in the Encampment district of Wyoming. Company moved from 100 Washington St., Chicago, and left no address.

**BOSSMO KISGRUBER. NORWAY.**

At Bossmo, Ranen, Norway. Ore values mainly in sulphur, which runs up to 50%; ores carry 0.5% and upwards in copper.

**BOSTON CONSOLIDATED COPPER & GOLD MINING CO., LTD. UTAH.**

Offices: 3–4, Great Winchester St., London, E. C., Eng., and 608 Dooly Blk., Salt Lake City, Utah. Capitalization £500,000. John E. Dudley Ryder, chairman; Samuel Newhouse, Salt Lake City, Utah, managing director; Geo. H. Johnson, secretary. Directors are preceding officers, Count Ward, Frank Gardner, M. I. Newhouse and Elmer E. Abercrombie. Lands, 51 claims, area 349½ acres, adjoining the Highland Boy mine of the Utah Consolidated, in the Bingham district of Utah. Property held through an American corporation. Company has developed very large bodies of low-grade ore and a limited amount of high-grade ore, with promise of further developments in the latter direction. Main ore bodies show oxides, at and near surface, running about 3½% copper and $2 per ton gold and silver, while lower openings show sulphide ore running about 4% copper, with $1 gold and a small amount of silver. Was working about 50 men at last accounts. Building of smelter is being considered.

**BOSTON GOLD-COPPER MINING CO.** **ARIZONA.**

Office: 15 Exchange St., Boston, Mass. Company advertises "detailed information and prospectus on application," but has never furnished same for any edition of this work, though repeatedly requested to do so. Claims to have 410 acres with "a vast amount of ore on and close to surface, and millions of dollars below." Existence of this fabulous wealth has apparently passed unnoticed in Arizona, as nothing is heard from there regarding the property.

**BOSTON GOLD-COPPER SMELTING CO.**

Had a smelter at Leadville, Colo., and purchased the rights to the Loder Hot-Blast process, a form of pyritic smelting. Rebuilt the old Elgin plant at an expenditure of several hundred thousand dollars, but it was not a financial success. Has had more or less litigation, and smelter was sold, December, 1902, to W. A. Miles, of Cleveland, Ohio.

**BOSTON GROUP.** **NEVADA.**

Owned by J. K. Miller, et al, Colorado Springs, Colo. Area, 110 acres. Limited amount of development work has exposed three promising veins, running 6" to 4' wide and assaying about 25% copper, $5 gold and 50 oz. silver per ton.

**BOSTON-ARIZONA MINING CO.** **ARIZONA.**

Office: 46 Broadway, New York. Mine office: Morristown, Maricopa Co., Ariz. Employs 4 men. Organized 1901, under laws of Arizona, with capitalization $5,000,000, shares $1 par. Henry Livingston Bowdoin, president; Geo. D. Christie, vice-president; T. J. Smith, secretary; W. T. Smith, treasurer and general manager. Lands, 10 unpatented claims, area 200 acres, in the Vulture district, showing 6 fissure veins, of which 2 average 4' to 20' width and 3,000' length, showing oxide and carbonate ores and giving assays of 1% to 40% copper and $1 to $22 gold per ton, with some silver and galena. Has 3 shafts, 20' to 50'; also 80' tunnel. Will test property with diamond drill, preliminary to further development by shafts and tunnels.

**BOSTON & BRITISH COLUMBIA COPPER CO.** **BRITISH COLUMBIA.**

Company's "mines" fell back into possession of the former owner; so far as can be ascertained company is moribund and stock worthless.

**BOSTON & BUTTE MINE.** **ARIZONA.**

At Gilbert, Yavapai Co., Ariz. W. H. Burrage, superintendent. Has steam power and was sinking shaft, with small force, at last accounts.

**BOSTON & CAROLINA COPPER MINING CO.** **NORTH CAROLINA.**

Was operating the Blue Wing mine in the Virgilina district, Person Co., N. C., in 1900; had office at 7 Water St., Boston, Mass.; present address unknown.

**BOSTON CLIMAX GOLD-COPPER MINING & INVESTMENT CO.** **WASHINGTON.**

Office: Union Trust Bldg., Providence, R. I. Benj. F. Harrison, president and general manager. Claims, about 240 acres, in Stevens Co., Wash. Company makes no returns.

**BOSTON-COLORADO COPPER MINING CO. COLORADO.**

Near Collins, Larimer Co., Colo. Idle at last accounts and no returns secured.

**BOSTON & DENVER CONSOLIDATED MINING & MILLING CO. COLORADO.**

Supposed to have property near Black Hawk, Gilpin Co., Colo., but no returns secured.

**BOSTON & MONTANA COPPER & SILVER MINING CO. MONTANA.**

Office: 199 Washington St., Boston, Mass. Mine office: Butte, Silver Bow Co., Mont. Organized under laws of Montana with capitalization $3,750,000, shares $25 par. Practically the entire stock issued is owned by the Amalgamated Copper Co. A. S. Bigelow, president; W. J. Ladd, secretary; Wm. Scallon, general manager; C. W. Goodale, assistant manager; John Gillies, mining superintendent; D. W. Brunton, consulting engineer; J. T. Morrow, smelter superintendent. Employs about 3,000 men. Mines owned are the Mountain View, Pennsylvania, Moose, Leonard, East Colusa, West Colusa, Comanche, Shafts Nos. 4 and 5 on the Meaderville flat, and other claims. Title to Minnie Healy mine is in dispute with the United Copper Co. The Boston & Montana is engaged in extensive litigation, which is the curse of the Butte camp. For the fiscal year ending June 1, 1902, the total costs of operation and maintenance were $6,066,001; gross receipts, $7,705,697, net profits, $1,639,696. Value of gold, silver and bluestone secured as by-products equals fully 3 cents per pound on the copper production.

The Leonard mine employs about 250 men, with 3-compartment main shaft about a quarter mile deep, connected underground with the Minnie Healy, East and West Colusa. The principal pumping plant of the Boston & Montana is in this mine. The East Colusa main shaft is about 1,500′ deep and the property employs 100 to 150 men. The West Colusa works about 300 men and has a quarter-mile main shaft. The Pennsylvania employs about 250 men, and its 3-compartment main shaft is about 1,600′ deep. The Mountain View has a 3-compartment main shaft, and underground connections with the Rarus, Leonard and West Colusa. The Moose is a small property with a single shaft.

The Boston & Montana made upward of 60,000,000 lbs. of refined copper yearly since 1894, until 1901. It is probably capable of turning out about 100,000,000 lbs. yearly, when working to full capacity. The mine is regarded by some authorities as the world's best copper property. Ore bodies are very extensive, and reserves of smelting grade ore are estimated at 3,000,000 tons. The mine has some stopes nearly 200′ wide and carrying copper averaging 8% to 10%, with good silver values. The mine is thoroughly equipped with steam and electric power and is in the best of condition both underground and on surface.

The smelter is at Great Falls, some distance from the mine, and until the completion of the Washoe plant of the Anaconda was the largest reduction works possessed by any copper mine. Power is secured from Great Falls, and there is also an auxiliary steam plant of 10,000 h. p. McDougal roasters have recently been added, giving very efficient work, at a remarkable reduction in cost. Adjoining the smelter is a very large electrolytic plant, which also treats blister copper from the Anaconda. Power for the electrolytic plant is transmitted by solid overlapping slabs of copper.

It is probable that the production for 1903 will be the largest in the mine's history, as there are many indications that the mine and plant have been put in order for a record-breaking production.

**BOSTON & NEVADA MINING CO. NEVADA.**

At Yerington, Lyon Co., Nev. J. V. Lane, superintendent. Property consists of Mountain View and Charley Ross claims, on which a little development work was being done, at last accounts.

**BOSTON & ST. MARY COPPER MINING CO. MONTANA.**

Office: presumably Great Falls, Montana; no returns secured.

**BOSTON & SEVEN DEVILS COPPER CO. IDAHO.**

Office: 53 State St., Boston, Mass. Mine office: Cuprum, Washington Co., Idaho. Organized 1899, under laws of New Jersey, with capitalization $5,000,000, shares $25 par. Lewis A. Hall, president; Chas. W. Whitcomb, vice-president; Ira J. Hersey, treasurer. W. B. Hancock, manager. Annual meeting, fourth Monday in March. Property includes Peacock, South Peacock, Helena, Arkansas and Decorah claims, more or less developed by shafts and tunnels. Has steam power equipment and 100-ton smelter at Weiser, Idaho. Worked about 75 men at last accounts.

**BOSTON & TEXAS COPPER CO. TEXAS.**

Office: Tremont Bldg., Boston, Mass. Property near Spalding, Archer Co., Texas. Organized 1898, under laws of Arizona, with capitalization $2,500,000, shares $10 par. E. M. Low, president; Jas. M. Wheaton, secretary and treasurer. No returns secured; cannot be learned that any mining is being done.

**BOSTON & TINTIC MINING CO. UTAH**

Office: 401 D. F. Walker Bldg., Salt Lake City, Utah. Mine office: Silver City, Juab Co., Utah. Property idle. Organized 1899, under laws of Utah, with capitalization $500,000, shares $1 par. Annual meeting, second Tuesday in January. Wm. H. Tibbals, president and general manager; C. E. Allen, vice-president; E. J. Waugh, secretary; R. L. Lyman, treasurer. Lands, 3 patented claims, area 45 acres, in the Tintic district, showing 2 fissure veins, average width 8″, length 20′, depth 200′, with estimated average value 35% copper, 4% to 53% lead, 40 cents to $2 gold and 14 to 120 oz. silver per ton. Shaft 240′.

**BOULDER COPPER MINING CO. SOUTH DAKOTA.**

Address: post-office box 118, Custer, S. D. W. A. Nelson, president. Capitalization, $1,000,000, shares, $1 par. Property, in Pennington Co., S. D., said to consist of gold and copper claims. No returns secured.

**BRADFORD COPPER MINING CO. ARIZONA.**

At Patagonia, Santa Cruz Co., Ariz. W. F. Balcom, superintendent. Was sinking shafts at last accounts; has steam power and employs a small force.

**BRAULIO MADRIGAL TUMBISCATA. MEXICO.**

At Apatzingan, Michoacan, Mexico. Opened by shaft and tunnel; has steam power. No returns secured.

**BRINDLE PUP MINING CO. ARIZONA.**

It has been alleged that a company by this name was opening a copper mine with ten men, at Dewey, Yavapai County, Arizona, but a letter to this address was returned October, 1902. Sad, indeed, that such a strikingly beautiful and appropriate name should be forever lost to the nomenclature of copper.

**BRISTOL COPPER MINING CO. NEVADA.**

Office: 201 Mining Exchange Bldg., Denver, Colo. Mine office: Pioche, Lincoln Co., Nev. Capitalization $2,000,000, shares $1 par. Lands, about 440 acres. Has 2 shafts, with steam and electric power. Wm. Gelder, manager; H. T. Freudenthal, superintendent. Ores carry copper, silver and lead values. Erection of a smelter was started, but all work was stopped in summer of 1902.

**BRISTOL MINE. CONNECTICUT.**

At Bristol, Conn. Has been worked during the past decade, but is now full of water with the machinery at the bottom of the mine. Just why the machinery should be at the bottom of the mine is not clear.

**BRITANNIA COPPER MINE, LTD.**

Offices: 4 Bishopsgate St., London, E. C., Eng. W. E. La Merton, secretary. Cannot be learned that company owns any mining property.

**BRITANNIA MINES. BRITISH COLUMBIA.**

On Howe Sound, Burrard district, B. C. F. M. Leonard, manager, at last accounts. Property makes large showing of gold-silver-copper ores. Mine is idle. Controlling interest said to be in the hands of F. Augustus Heinze, of Butte, Mont., and associates.

**BRITANNIA MINING CO. MONTANA.**

Office: Milwaukee, Wis. Mine office: Butte, Silver Bow Co., Mont. Organized 1899, with capitalization $350,000. G. R. Nickey, president; G. B. Best, secretary. Has 3 parallel veins, 3′ to 30′ wide, carrying gold, silver and copper. Employs about 20 men. Main shaft, about 350′. Has steam power and air compressor. Ore shipped has averaged about $35 per ton, after deducting transportation and smelting charges. Property, while small, is regarded as well managed and valuable.

**BRITISH GOLD & COPPER MINING CO. SOUTH DAKOTA.**

Supposed to be operating in the Black Hills district, presumably in Pennington Co., S. D., but no returns secured.

**BRITISH GOLD MINES OF MEXICO, LTD. MEXICO.**

Offices: Bush Lane House, Cannon Street, London, E. C., Eng. Mines: El Carmen (gold only), Federal District of Mexico; Colorado Ures mine (gold, silver and copper), at Torres, Sonora, Mexico. R. J. Price, chairman; G. Thompson, secretary; J. F. Allen, managing director; A. L. Waters, manager at Colorado Ures mine, Sonora. Capital, nominal, £100,000; issued, £70,080. At the Colorado Ures mine there is a smelter, newly built, also 10 stamps for gold. Steam power is used; mine is developed by shafts and tunnels; about 300 men are employed.

**BRITISH AMERICAN GOLD AND COPPER CO. SOUTH DAKOTA.**

Had an office at 52 Broadway, Deadwood, S. D., and mining lands near Hornblende, Pennington Co., S. D. Letter sent to company's address returned unclaimed, December, 1902.

**BRITISH COLUMBIA AGENCY, LTD. BRITISH COLUMBIA.**

This company did some exploring on the Modoc and Kitchener claims, Alberni Canal, B. C., in 1901, securing a fair showing of chalcopyrite and auriferous quartz.

**BRITISH COLUMBIA CHARTERED CO. BRITISH COLUMBIA.**

At Summit, Yale & Cariboo district, B. C. S. F. Parrish, Greenwood, B. C., manager. Ores carry gold and copper values. Property equipped with steam power; employed about 50 men, at last accounts.

**BRITISH COLUMBIA COPPER CO., LTD. BRITISH COLUMBIA.**

Office: 31 Nassau St., New York. Mine office: Anaconda, B. C. Employs 180 men. Organized 1898, under laws of West Virginia, with capitalization $1,250,000, shares $5 par, non-assessable. Jas. F. Tichenor, president; F. L. Underwood, vice-president; R. H. Eggleston, secretary; C. E. Laidlaw, treasurer; S. C. Holman, mine superintendent; Frederic Keffer, general manager; Paul Johnson, smelter superintendent. Lands, 6 claims, area 62 acres, crown-granted, also smelter site of 60 acres, in the Yale and Cariboo district, B. C. Property contains several copper deposits, of which one is being developed, this having an average width of 175′, length of 1,300′ and known depth of 500′, carrying chalcopyrite. Two-compartment main shaft is 325′ deep; 3 main tunnels have an aggregate length of 2,400′; about 6,000′ of underground openings have been secured. Estimated amount of ore in sight, 6,000,000 tons, of which 3,000,000 tons are blocked out for stoping. Mine has excellent equipment, including 35-drill cross-compound air compressor, 20x42″ hoist, crushers, Robins belt conveyors, Jeffrey bucket elevator, engines, boilers, machine shop, smithy, electric light plant, etc. Smelter is at Anaconda, 2½ miles from mine, and has two water-jacket furnaces, 42x150″, with boilers, blowers, engine, etc. Product is turned out as matte of about 50% tenor. Company plans to install two more furnaces, stands of convertors and a flue dust furnace in 1903. Profits of operation to date have gone into the development of the mine and equipment of the mining and smelting plant. Property is one of great value and already an important producer.

**BRITISH COLUMBIA EXPLORATION, LTD. BRITISH COLUMBIA.**

An English company, of which J. Argall, Kamloops, B. C., is manager. At Kamloops, Yale & Cariboo district, the Lucky Strike and Iron Mask claims are being developed by shafts, with about 25 men, and are showing gold and copper. At Estere Basin, Nanaimo district, the Colossus group is being developed, where about 1,800′ of open work was done in 1901 by 12 men. The tunnel is about a quarter mile long, and assays of the ore average about $16 per ton in gold, silver and copper.

**BRITISH COLUMBIA & LAKE SHORE COPPER CO., LTD.** **BRITISH COLUMBIA.**

The Blue Bell mine of this company is located at Summit, Yale & Cariboo District, B. C. John Dorsey, manager. The mine is opened by a shaft and fitted with steam power. Ore carries both gold and copper.

**BRITTON GOLD MINING CO.** **WASHINGTON.**

Office: Whatcom, Wash. Henry L. Manville, president. Three veins opened by tunnel, show good assays in gold and copper. Closed down for winter in October, 1902.

**K. K. BERG & HUETTENVERWALTUNG BRIXLEGG.** **AUSTRIA.**

At Brixlegg, Austrian Tyrol. Is an active producer, securing considerable silver and a little gold as by-products. Gustav Kroupa, general manager; Vincenz Svoboda, superintendent and mining engineer; Cayetan Hummel, smelter superintendent; Josef Link, purchasing agent. Mining lands, about 22½ hectares. Ores exclusively sulphide. Company has smelter at Brixlegg, this having blast, reverberatory, refining and anode furnaces, electrolytic plant and facilities for the manufacture of the raw copper. Estimated production of company, 220 metric tons copper, 600 kilograms silver and 5 kilograms gold, in 1902; approximately same production for 1903.

**BROKEN HILL PROPRIETARY SILVER MINE.** **AUSTRALIA.**

This famous silver mine at Broken Hill, New South Wales, secures about 300 tons of copper yearly, as a by-product from the smelting of its silver ores.

**BROMIDE COPPER CO.** **NEW MEXICO.**

Supposed to have mineral lands near Tres Piedras, Taos Co., N. M., but no returns secured.

**BROMIDE COPPER & GOLD MINING CO.** **NEW MEXICO.**

Has 22 claims in the Bromide district of Rio Arriba Co., N. M., and did considerable development work in 1902. No returns secured.

**BROOKLYN COPPER & GOLD MINING CO.** **WASHINGTON.**

Office: Auditorium Bldg., Spokane, Wash. Lands, in Colville Reserve, Wash. Capitalization, $100,000. M. L. Pershell, president; C. Von Gilsa, secretary. Company states that property is not sufficiently developed to make a statement for publication.

**BROOKLYN MINING CO.** **CALIFORNIA.**

At Dale, San Bernardino Co., Cal. H. H. Ames, superintendent. Ores carry gold and copper; has gasoline power and 3-stamp mill; employs about 15 men.

**BROOKLYN MINING CO.** **COLORADO.**

At Silverton, San Juan Co., Colo. J. W. Starkwether, superintendent. Ores carry gold, silver and copper values. Small force employed at last accounts.

**BROOKLYN MINING CO.** **NEVADA.**

Near Contact, Elko Co., Nev. Moses Jones, superintendent. Was developing copper ore body by shaft and tunnel, with gasoline power and small force, at last accounts.

**BROPHY, HUMPHREY & CO.** **MEXICO.**

Operate the San Fernando mines at Ensanada, Baja California, Mex. David Goldbaum, superintendent. Opened by shafts. About 20 men employed.

**BRUCE COPPER MINES, LTD.** **ONTARIO.**

Offices: 31-3, Palmerston Bldgs., London, E. C., Eng. Marquis of Queensbury, chairman; Lewis J. Abrahams, manager. Capital, nominal, £100,000. Property is the old Bruce Mines, on Georgian Bay, Algoma, Ont. These were opened in 1846, contemporaneously with the first important developments in the Lake Superior district, and closed in 1876, after producing copper valued at $3,300,000. Present depth, nearly 500′. Ores are sulphide, mainly chalcopyrite in quartz gangue, occurring in several parallel fissure veins, traversing diabase and running nearly east and west. Two principal veins are 3′ to 15′ wide, ore averaging about 5% copper. Plant has been remodeled and new machinery added; now includes rock crushers, rolls, jigs, hydraulic sizers, round tables, Griffin mills and Frue vanner, with capacity to handle 400 tons or upward daily. Mine said to have ore blocked out for two years' production. Was employing a small force at last accounts, and lacked convenient smelting facilities.

**BRUNSWICK MINING CO.** **COLORADO.**

At Tin Cup, Gunnison Co., Colo. Ore values mainly gold and silver, but also a little copper; has steam power and 100-ton concentrating mill; employs about 25 men.

**BUCHANAN MINE.** **CALIFORNIA.**

Near the northern boundary of Madera County, a little south of the Green Mountain mine in Mariposa county, and 5 miles northeast of Daulton, Cal. Owned by G. A. Pherson. Opened by shafts and tunnels. Vein matter, diabase and amphibolite schist, both mineralized. Ores, oxides near surface, unaltered sulphides at depth. Shipments made by lessees average about 15% copper and $3 gold per ton. Has been a considerable producer in the past.

**BUCKEYE CONSOLIDATED GOLD & COPPER MINING CO.** **UTAH.**

Former office: 414 Atlas Blk., Salt Lake City, Utah. Dead.

**BUENA VISTA COPPER MINES, LTD.** **MEXICO.**

Offices: 11, Queen Victoria St., London, E. C., Eng. Mines, in Lower California, Mexico. Lord C. Pratt, chairman; J. L. Smith, secretary. Capital, nominal, £50,000. Mines are opposite Guaymas, not far from the Boleo, and include the Buena Vista and San Bruno properties, area 45 acres, with 100 acres adjoining under option; held on lease at 10% royalty; purchase consideration, £3,000 cash and £32,000 stock.

**BUENA VISTA COPPER MINING CO.** **CALIFORNIA.**

Has the Bull Run and Russell mines, former on Wharf's ranch, Amador Co., Cal. Vein is schistose diabase carrying sulphide ore.

**BUENA VISTA MINING & MILLING CO.** **ARIZONA.**

At Washington, Santa Cruz Co., Ariz. F. Cox, manager. Copper ores carry gold and silver values; has steam power; no returns secured.

**BUENOS AIRES MINING CO. MEXICO.**

Office: El Paso, Texas. Mine office: Cusihuiriachic, Mexico. W. C. Rollins, superintendent. Property is La Lola and Muriel mines, carrying gold, silver and copper. Opened by shafts and tunnels; gasoline power. Has concentrator and 40-ton smelter. Employs about 40 men.

**BUFA MINING, MILLING & SMELTING CO. MEXICO.**

Office: 709 Lankershim Bldg., Los Angeles, Cal. Mines at La Bufa, Sahuaripa district, Sonora, Mex. Mine active, employing 300 men in dry season and about 150 in wet season. Organized 1902, under laws of Arizona, with capitalization $1,500,000, shares $1 par, non-assessable. Davis Richardson, president; Wm. E. Richardson, vice-president and general manager; Baron W. Riley, secretary; L. R. Richardson, treasurer; Frank Richardson, superintendent; Arthur A. Lane, mill superintendent; P. Quinn, mining captain. Lands, 35 patented claims, area 91 acres, also 5,000 acres of other lands and 3-acre millsite. Claims show 6 fissure veins, of which 2 are being developed, these having an average width of 4′, length 400′ and opened to depth of 600′ on incline, with average of 12% copper, 10% lead and 325 oz. silver per ton. Ores, sulphides and argentiferous tetrahedrite. Has three shafts, deepest 470′, and 6,500′ of underground openings; 15,000 tons of ore blocked out for stoping. Mine has complete steam power equipment, also concentrating and leaching mill of 20 tons daily capacity, with boilers, engine, jigs, 2 Woodbury concentrating tables, crushers, rolls, 5 stamps, 2 roasting furnaces and tanks for leaching and precipitation. Company is planning to increase capacity of concentrator, building a smelter to produce matte, sinking a vertical shaft and developing ore bodies previously untouched, in 1903. Property paid $175,000 dividends previous to incorporation of present company, which contemplates paying semi-annual dividends, beginning January, 1903.

**BUFFALO GROUP. MONTANA.**

Claims in the Scratch Gravel district of northern Montana. No returns secured.

**COMPANIA DEL CASTILLO DE BUITRON. SPAIN.**

Operates a group of mines, including La Concepcion with 42 hectares at Almonaster la Real, and La Poderosa with 6 hectares at Zalamea, Huelva, Spain; is also exploring a group of 5 old mines, area 18 hectares, in the same district. F. C. Hills & Co., of London, are in charge of the company's operations. Annual production estimated at 1,500,000 lbs. of fine copper.

**BULL DOMINGO MINING CO. WYOMING.**

Near Hecla, Laramie Co., Wyo. John L. Morgan, superintendent; no returns secured.

**BULLION MINING CO., LTD. IDAHO.**

Office: Wallace, Shoshone Co., Idaho. Employs 8 men. Organized 1902, under laws of Idaho, with capitalization $1,000,000, shares $1 par. B. F. O'Neil, president; Jas. H. Taylor, secretary; Jas. F. McCarthy, treasurer; D. A. McKenzie, general manager. Lands, 4 unpatented claims, area 80 acres, showing fissure vein of 12′ width, traced 170′, giving assays 14% copper,

$4 gold and 12 oz. silver per ton, from sulphide ore. Shaft, 100′; tunnels, 80′ and 170′. Will continue sinking and install hoist, pump and air compressor in 1903.

**BULLION BECK & CHAMPION MINING CO.** **UTAH.**

At Eureka, Juab Co., Utah. P. L. Farnsworth, manager. Secures a limited amount of copper annually as a by-product from gold-silver-lead-copper ores; has steam and electric power and concentrating mill. Employs about 150 men.

**BULLWHACKER GOLD & COPPER CO.** **ARIZONA.**

Promoted by H. B. Clifford & Co., 10 Wall St., New York. Property, 4 miles east of Prescott, Yavapai Co., Ariz. No returns secured.

**BULLY HILL COPPER MINING & SMELTING CO.** **CALIFORNIA.**

Consolidated with Mount Shasta Gold Mines Corporation, October, 1902.

**BUNKER HILL-SULLIVAN COPPER MINING CO.** **WASHINGTON.**

Office: Vanderbilt Blk., Tacoma, Wash. Fiscal agent: Joshua T. Nowell, 53 State St., Boston, Mass. Mine office: Index, Snohomish Co., Wash. Capitalization $1,000,000, shares $1 par. Chas. G. Reiter, president; John R. Brooks, vice-president; John D. Campbell, secretary; Chas. H. Eckerson, manager. Property, Copper Bell group of 9 claims, 5 miles northwest of Index, has 2 veins carrying chalcopyrite said to average 8% copper with some silver; about 1,500′ of underground openings; steam plant and power drill.

**BUNKERVILLE MINING CO.** **NEVADA.**

At Bunkerville, Lincoln Co., Nev. L. C. Bradley, superintendent. Has steam power and was sinking shaft with force of about 15 men at last accounts.

**BURLINGTON COPPER MINING CO.** **WYOMING.**

Supposed to have property in the Encampment district of Carbon Co., Wyo. No returns secured.

**BURNS MINING CO.** **WASHINGTON.**

Near Darrington, Snohomish Co., Wash. Thos. Perks, superintendent. Was driving tunnel on the Justice and Myrtle claims, with small force, at last accounts.

**BURRA BURRA MINE.** **AUSTRALIA.**

Address: care Smith & Roberts, Davenport, Waymouth St., Adelaide, South Australia. Mine about 100 miles northeast of Adelaide. Opened 1845; abandoned many years and reopened circa 1900. Has oxidized ores, mainly malachite, rich but irregular, in the upper levels; sulphides below. Property has paid dividends of £800,000 and was a large producer for many years, having made 51,622 long tons of fine copper previous to 1877.

**BURRAGA COPPER CO.** **AUSTRALIA.**

In the Bathurst district, Central division of New South Wales, one mile east of Lloyd mine. Opened 1877; production, 570 long tons in 1898. Ores sulphide, occuring in a belt of highly altered rocks ranging from porphyry to schistose slates. Ores carry 1 to 3 oz. silver per ton. Mine about 800′ deep; smelter has 3 reverberatory furnaces, using wood for fuel; product is sent as 47% matte to Lithgow, for refining.

**BURTON CONSOLIDATED COPPER CO. WYOMING.**

Office: Encampment, Carbon Co., Wyo. Claims in vicinity. R. R. Burton, superintendent. No returns secured.

**BUTLER MINING & MILLING CO. UTAH.**

Near Bingham Canyon, Salt Lake Co., Utah. A. C. Lindskog, superintendent. Has gold-copper ores, opened by tunnel; employed about 25 men at last accounts.

**BUTTE COPPER CO. MONTANA.**

Supposed to be composed of eastern men and to hold bonds on the Amazon, Jessie and other claims in the eastern part of Butte, Silver Bow Co., Mont. Unknown in Butte.

**BUTTE CONSOLIDATED MINING CO. MONTANA.**

At Butte, Silver Bow Co., Mont. E. H. Renisch, superintendent. Operates the Ella mine, having 2-compartment shaft about 700′ deep. Copper ore is auriferous. No returns secured.

**BUTTE GOLD, SILVER & COPPER CO. WASHINGTON.**

Office: Spokane, Wash. Lands, about 25 miles from head of Lake Chelan, showing 2 veins, one 8′ wide opened by tunnels.

**BUTTE MINE & EXPLORATION CO. MONTANA.**

Bought the Pacific mine in East Butte for $40,000 in 1902, and made some shipments of good ore during the year. Is developing by sinking and drifting.

**BUTTE MINING & DEVELOPMENT CO. MONTANA.**

Office: Butte, Mont. Lee Mantle, president. Organized 1901, under New Jersey laws, with capitalization $2,000,000. Owns the Emma mine in the heart of the city, and had a shaft down about 700′ at last accounts. Developments at close of 1902 more encouraging than previously.

**BUTTE & ARIZONA COPPER CO. MONTANA.**

Office: Butte, Mont. Geo. S. Lander, president; Samuel A. Hall, secretary. Has bond and lease on the Metz claim and options on other claims in Independence district of Silver Bow Co., Mont., and is thought to have mining claims in Arizona, but no returns secured.

**BUTTE & BINGHAM COPPER CO. UTAH.**

Has claims at Bingham Canyon, Salt Lake Co., Utah. O. Roberts, superintendent; W. H. Nichols, president; no returns secured.

**BUTTE & BOSTON CONSOLIDATED MINING CO. MONTANA.**

Office: 199 Washington St., Boston, Mass. Practically entire stock issue is owned by the Amalgamated Copper Company. John Gillies, superintendent. Property includes Silver Bow, Michael Davitt, Blue Jay, East Grey Rock, West Grey Rock and Berkeley mines, also several thousand acres of placer lands. Shaft No. 6 was started on Meaderville Flat, with 2 compartments, in 1900. The Berkeley has a 3-compartment shaft about 1,000′ deep and works about 75 men when full force is employed. The Blue Jay has a shaft about 1,100′ deep, 2 compartments to 600′ level and 3 compartments below. The East Grey Rock has a 3-compartment shaft 1,600′ deep and works 175 men. The Silver Bow No. 1 has a 3-compartment shaft about 1,500′ deep and can work 150 men. Silver Bow No. 2 has a 4-compartment shaft about 600′ deep and can work 75 men. The mines all produce copper ore carrying considerable silver, the blister copper averaging about 100 oz. silver per ton. Smelter has a daily capacity of about 700 tons and does more or less custom work. Annual production, 10,000,000 to 15,000,000 pounds.

The appended table gives comparative figures for the fiscal years ending June 1, 1901 and June 1, 1902:

| | 1902. | 1901. |
|---|---|---|
| Tons of ore extracted | 189,499 | 214,310 |
| Cost of mining | $ 767,754 | $969,047 |
| Cost of transportation | 36,523 | 41,019 |
| Total cost of reduction | 404,723 | 551,344 |
| Paid for labor | 709,689 | 888,860 |
| Machinery and supplies | 462,787 | 631,531 |
| Marketing and selling | 199,961 | ....... |
| Net proceeds | 165,617 | 586,053 |

**BUTTERNUT GOLD & COPPER MINING CO. ARIZONA.**

Property, presumably in the Big Bug district of Yavapai Co., Ariz. Has main shaft down about 300′ and shipped ore to custom smelters during 1902.

**EL CABELLO MINE. MEXICO.**

At Inde, Durango, Mexico. Wm. Benton, owner; J. M. De La Torre, superintendent. Opened by a shaft and equipped with steam power; produces silver and copper; works about 50 men.

**CABEZAS DEL PASTO MINES. SPAIN.**

At Puebla de Guzman, Huelva, Spain, Owned by C. & J. Sundheim, who have operated the property since 1887. Wm. Guthrie Bowie, general manager; Don Jorge Riecken, superintendent. Property consists of 6 government concessions, area 104 hectares, with about 300 hectares of adjoining lands. Has 12 ′shafts, deepest 104 metres, with 5,000 to 6,000 metres underground openings. Ore developed for immediate mining is estimated at 750,000 tons pyritic ore and 1,500,000 tons of cupriferous schists. Lenses apparently increase in size at depth. Mine is opened by overhand stoping and dry-walling is used in depleted stopes. Ores carry 1½% to 5% copper, 46% to 52% sulphur and 40% to 44% iron. The cuprous schists range 0.25% to 30% copper. All pyritic ore above 1½ % copper and all schists above 10% copper are exported. Lower grade ores are weathered at the mine to produce cement copper, and the washed ore free of copper is sent to France for treatment to secure sulphur. The water from the mines, where 80,000 to 100,000 cubic metres are in constant storage, carry up to 9 kilograms of copper in solution to each cubic metre, most of which is saved by cementation. The cement copper is washed and classified, the best quality averaging 98.5% copper, which is much the best grade of cement copper produced anywhere. Mining by overhand stoping and rock filling is said to prove safer and cheaper than open-cast operations. Surface plant includes Robey hoisting and pumping engines and mine has tramline with 76 cm. gauge, also aerial tram to the wharves at La Laja, on the river Guadiana.

**CABRALES COPPER SYNDICATE, LTD. SPAIN.**

Offices: 18, Walbrook, London, E. C., Eng. Capital, nominal, £12,000. Supposed to have mining property in Spain, but no returns secured.

**CABRERA MINING CO. MEXICO.**

Mine office: Velardena, Durango, Mexico. M. Levy, superintendent; employs about 25 men; developed by shafts; produces copper, silver and lead.

**CACTUS SMELTING & COPPER CO. UTAH.**

Absorbed by the Royal Copper Mining company.

**SOCIEDAD MINAS DE CALA. SPAIN.**

Offices: Bilbao, Vizcaya, Spain. Mines at De Cala, Santa Olalla, Huelva, Spain. Property is a group of eight mines, area 346 hectares; product is iron-copper pyrites and magnetic iron. In course of development at present.

**CALABASAS COPPER CO., LTD. ARIZONA.**

Office: 66 Broadway, New York. Mine office: Tucson, Pima Co., Ariz. Organized 1901, under laws of Arizona, with capitalization $5,000,000, shares $1 par. Fred. W. Pope, president; Geo. F. Jacoby, vice-president; Jas. T. Taitt, secretary; H. H. Douglas, treasurer. Annual meeting, third Tuesday in January. Lands, 380 acres in Tyndall district, Santa Cruz Co. Company claims ore body 8′ wide and one mile long, and estimates 100,000 tons of 28% ore in sight, which is too high. Has 50-ton water-jacket smelter. No returns secured for 1902.

**CALCANTE COPPER & NICKEL MINES. ITALY.**

At Traves, Torino, Italy, in the western Alps of Piedemont. Once a large producer, but now idle. Nickel, cobalt and copper, latter occurring as chalcopyrite, are found in stratified archaic rocks.

**CALEDONIA COPPER CO. MICHIGAN.**

A proposed organization to take over the Flint Steel and adjoining mines, in Ontonagon county, Mich. Company not formed.

**CALEDONIA COPPER CO., LTD. NEW CALEDONIA.**

Offices: Salisbury House, London, E. C., Eng. G. Allan, chairman; A. J. Lindsay-Simpson, secretary. Capital, £750,000. Debentures, £75,000 authorized. Property, the Ao and Pilou groups of copper claims, area about 4,000 acres, in the Diahot district of New Caledonia. Has 200-ton concentrator, to be doubled in capacity, and contemplates erecting a smelter.

**CALIFORNIA COPPER CO. CALIFORNIA.**

A New York corporation of this title bought the Ne Plus Ultra and other copper claims near Daulton, Madera Co., Cal., in 1898. Claimed property has 100-ton smelter and employs 50 men, but letter was returned October, 1902, with notation "No business being done." Ores proved refractory and plant unsuited to economical extraction. It has been proposed to erect a sulphuric acid plant, but stock of company is non-assessable and shareholders are apparently disinclined to furnish further funds.

**CALIFORNIA GOLD & COPPER CO. CALIFORNIA.**

Supposedly at Spenceville, Nevada Co., Cal.; no returns secured.

**CALIFORNIA IMPROVEMENT CO. CALIFORNIA.**

Office: Oakland, Cal. F. M. Smith, president. Owns Leona Heights mine, south of the Alma, in Alameda Co., Cal. Has about 200′ of tunnels, with 12′ ore body under prominent gossan outcrop. Ore is sulphide, apparently well suited to manufacture of acid.

**LA ÇOMPANIA MINA DE CALIFORNIA. MEXICO.**

Mine office: Cumuripa, Sonora, Mex. Organized 1901, with capitalization $1,000,000. Has 20 pertenencias of land; no returns secured.

**CALIFORNIA & ARIZONA COPPER MINING CO. ARIZONA.**

Address: care of Pacific States Mining & Investment Co., 326 Post St., San Francisco, Cal. Has 7 claims, area 140 acres, in the Huachuca Mountains, Cochise Co., Arizona, 17 miles west of Bisbee and 12 miles west of Don Luis station on the Arizona & Southeastern Ry.

**CALIFORNIA COPPER KING CO. CALIFORNIA.**

Office: 218 So. Broadway, Los Angeles, Cal. S. P. Creasinger, president; H. R. Adams, first vice-president and manager; Stanley Harris, secretary and treasurer. Lands, 21 claims, in two groups, on Pahlen and McCoy mountains, Riverside Co. Opened by shafts showing various ore bodies, 4′ to 40′ wide. No returns secured.

**CALIFORNIA COPPER SYNDICATE, LTD. CALIFORNIA.**

Offices: 188, St. Vincent St., Glasgow, Scotland. Capital, nominal, £30,000. N. W. Helme, chairman. Owns a group of claims in Fresno Co., Cal. No particulars secured.

**MINA DE CALINNHA. PORTUGAL.**

Owned by a French company; M. Paul Chapuy, Santa Appolonia, Lisbon, Portugal, mining director. Is exporting iron-copper pyrites to England.

**CALSTOCK TIN & COPPER CO., LTD. ENGLAND.**

Offices: 15, Angel Court, London, E. C., Eng. and Rue St. Marc, 77, Paris, France. T. E. De La Croix, chairman; H. B. Greenwood, secretary; C. F. Thomas, mine manager. Property is Prince of Wales tin mine, Calstock, Cornwall, Eng., producing mainly tin, but making a little copper also.

**CALUMET COPPER MINING CO. WASHINGTON.**

Letter addressed to company at Index, Wash., returned unclaimed, October, 1902.

**CALUMET MINING & MILLING CO. WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. S. E. Phelps, secretary. Was working, December, 1902. No returns secured.

**CALUMET & ARIZONA MINING CO. ARIZONA.**

Office: Calumet, Mich. Mine office: Bisbee, Cochise Co., Ariz. Organized 1901, under laws of Arizona, with authorized capital $2,500,000, in $10 shares, $2,000,000 issued. Chas. Briggs, president; John S. Dymock, vice-president; Gordon R. Campbell, secretary; Peter Ruppe, treasurer. Directors are preceding officers, Jas. Hoatson, Thos. Hoatson, Thos. F. Cole, Chester A. Congdon, Chas. d'Autremont, Jr. and Geo. E. Tener. I. L. Merrill, superintendent; D. E. Heller, smelter superintendent; H. A. Smith, mining engineer; J. G. Merrill, mining captain. Lands, 11 patented claims, area 160 acres, also 800-acre smelter site, in the Warren district of Cochise Co. Ores occur in blanket veins or lenses of immense size, estimated by company to have an average value of 8% copper, and carrying considerable gold and silver. The mine made a very indifferent surface showing and nothing of particular value was encountered above a depth of 700′, at which point immense lenses were encountered, these carrying oxide and carbonate ores, with just enough sulphides to make a proper furnace mixture to give easy smelting and clean slags. Considerable native copper has been encountered from time to time. Main shaft is 1,200′ deep, of large size and exceptionally well sunk and timbered, surmounted by a 78′ steel gallows-frame with 114′ ore bin. Also has air shaft of 800′ and about 3 miles of underground openings. Has Nordberg direct-acting hoists, 20x60″ cylinders, that can raise a 3-deck cage at the rate of 2,000′ per minute. Surface improvements include carpenter and machine shops, smithy, timber mill for the framing of mine sets, etc. A 25-kilowatt generator supplies electricity for light, and power for ventilating-fans.

Smelter is at Douglas, 25 miles from the mine, and served by the El Paso & Southwestern Railway. The building has room for three 250-ton furnaces. First furnace was blown in Nov. 15, 1902, second will go in blast about March, 1903, and the third is to be installed before the close of the year. Matte is discharged by furnace into tilting wells, and is taken thence by an electric traveling crane to the converters. Power is furnished by a 400-h. p. engine. Smelter plant was furnished by the Allis-Chalmers Co. An ample water supply is secured from wells. Mine has no concentrator, as the ore is of too high grade at present to render concentration advisable. Production for 1902, about 1,200,000 pounds; output for 1903 estimated by company as 30,000,000 pounds. This property is without question one of the future great mines of the world.

**CALUMET & BISBEE DEVELOPMENT CO. ARIZONA.**

Office: Calumet, Mich. Mine office: Bisbee, Cochise Co., Ariz. Capitalization $400,000, shares $10 par. Frank S. Carlton, president; Frank A. Kohlhaas, vice-president; J. Wesley Downing, treasurer; Wm. R. Oates, secretary; Scott Turner, superintendent; Geo. O. Beehler, clerk. Lands, 23 claims, known as Blair group, adjoining the South Bisbee. Property makes no particularly promising surface showing, but in this district the values are almost invariably found at considerable depth, and the South Bisbee property is showing good ore within 150′ of the Calumet & Bisbee land. Company will sink double-compartment shaft to depth of 1,000′ to 1,500′. Company is composed of men of integrity and financial strength.

**CALUMET & HECLA MINING CO. MICHIGAN.**

Office: 12 Ashburton Place, Boston, Mass. Mine office: Calumet, Houghton Co., Mich. Is one of the largest copper producers of the world, working about 5,000 men. Organized 1871, under Michigan laws, as consolidation of the Hecla, Calumet and minor companies, reincorporated 1900 for 30 years. Capitalization $2,500,000, the maximum allowed under Michigan laws, in 100,000 shares, par $25, $12 paid in and $803.50 per share paid in dividends to close of 1902. Has about 3,500 shareholders of record. Annual meeting in August;

fiscal year ends April 30. Alexander Agassiz, president; T. A. Livermore, vice-president; Geo. A. Flagg, secretary and treasurer; Alexander Agassiz, Francis L. Higginson, Francis W. Hunnewell, Quincy A. Shaw, Jr., and Jas. N. Wright, directors; James MacNaughton, superintendent; John Duncan, assistant superintendent; Will A. Childs, second assistant superintendent; W. M. Gibson, third assistant superintendent; J. H. Lathrop, chief clerk; J. N. Cox, assistant clerk; Fred S. Eaton, cashier; E. S. Grierson, chief engineer; E. D. Leavitt, consulting mechanical engineer; Jas. Milligan, chief mining captain; W. H. Cake, mill superintendent; Jas. B. Cooper, smelter superintendent at Lake Linden, Mich.; Senator Chas. Smith, chief clerk at Lake Linden smelters; Maurice B. Patch, smelter superintendent and Geo. M. Kendall, chief clerk, at the Buffalo Smelting Works, Buffalo, N. Y.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount of cash paid in on capital stock | $ 1,200,000.00 |
| Entire amount invested in real estate | 17,530,917.46 |
| Amount of personal estate | 4,600,782.34 |
| Amount of unsecured or floating debt | 1,200,370.34 |
| Amount due the corporation | 1,891,410.14 |
| Production of copper, 1901, in pounds | 82,519,676 |

For the fiscal year ended Apr. 30, 1902, cash assets and insurance fund, mostly in cash, were $4,467,171 as compared with $3,869,868 one year preceding. Deducting liabilities, the balance remaining as surplus was $3,592,779, compared with $2,168,130 on April 30, 1901. Production of refined copper for fiscal year ended Apr. 30, 1902, was 39,982 tons, and net earnings for fiscal year were $4,924,649; cost of copper produced, about 8½ cents per pound. Costs are being materially reduced in the present fiscal year. Official statements given yearly to shareholders are more remarkable for their brevity than for any information contained. Complaints are met with the statement that any dissatisfied stockholder may sell his entire holdings, en bloc, to the management, at the current market price of the shares. The offer has never been accepted, as the mine has paid larger dividends than any other mining company ever organized. Dividends for 1902 were $25 for the year. Largest dividends were $100 per share, or a total of $10,000,000, paid in the calendar year 1899, establishing a world's record for mining profits. Detailed figures of dividends by years will be found in the statistical chapter.

The Calumet & Hecla has made about 55% of the total copper production of Lake Superior, and is now making about 8% of the world's copper output. At the close of 1902 the Calumet & Hecla is stamping nearly 6,000 tons daily, which, at 2½%, or 50 pounds of fine copper per short ton of rock, would give an annual production at the rate of about 90,000,000 lbs. The earnings for 1902 have probably been at least 50% greater than the dividend disbursements, and the surplus of the company is being rapidly restored. While the dividend rate has been reduced to its old basis of $5 per quarter, the finances, equipment and mine are in such condition that the company is fully prepared to meet disaster of any sort, or any industrial war. Great economies have been effected under Mr. MacNaughton's management, and further savings are possible, and are being given consideration. The present force of 5,000 employes is mining, milling and smelting more rock than ever before handled. In justice to the preceding local management, it should be said that the discontinuance of work on the amygdaloid shafts made possible a large reduction in forces, and that Mr. MacNaughton has probably received more cordial support in his policy of retrenchment and economy than would have been given a few years ago, when the net earnings of the mine were of almost fabulous amount.

Mineral lands comprise about 2,750 acres, in a compact tract in Sections 11, 13, 14, 15, 22, 23 and 24, Town 56 North, Range 33 West. The company also owns considerable tracts west of the Tamarack mine that undoubtedly carry the underlay of the Calumet conglomerate, but at such stupendous depths that it would require a vertical shaft of about two miles in depth to reach the lode. The cost of sinking such a shaft and equipping it with adequate machinery would probably be not less than eight to ten millions of dollars and the heat at such great depth would prohibit mining, unless artificial refrigeration were provided. Furthermore, it is very doubtful if the rock would be worth mining. In addition to its mineral lands, the Calumet & Hecla owns vast tracts of forest land in various portions of the upper peninsula of Michigan and northern Wisconsin. Much timber is bought from jobbers also.

The mine is opened on the Calumet conglomerate, the extensions of which, to the north and south of the Calumet & Hecla, have proved unprofitable wherever mined, though the underlay of the lode, to the westward, is opened by vertical shafts at the Tamarack mine, and has given good returns.

The average strike of the conglomerate is N.39° E., with dip to the west of north at an average angle of 37° 30′ with the horizon. The lode has an average width of 12′ to 15′, sometimes reaching 20′. The Osceola amygdaloid outcrops 730′ east of the Calumet conglomerate, with parallel strike and average dip of about 40°. The Kearsarge amygdaloid, which is very rich to the northward, also underlies the Calumet & Hecla lands, outcropping some distance east of the Osceola lode. Some very rich conglomerate rock was found on Calumet & Hecla lands lying west of Tamarack, in October, 1902, but was probably secured from a boulder rather than from a cupriferous bed in place. Considerable copper is found in the upper part of the trap bed underlying the conglomerate, and a portion of this is milled.

The Calumet & Hecla mine proper is developed on the Calumet conglomerate by the incline shafts of the Calumet, Hecla and South Hecla branches, and by the Red Jacket vertical shaft, the conglomerate having been opened for a distance of nearly two miles along its outcrop. An entirely new mine was opened, 1897–1900, on the Osceola amygdaloid lode, paralleling the conglomerate. The Osceola bed is opened by five shafts, Nos. 13 to 17, numbered from south to north, and approximately 2,300′ apart, developing two miles on this lode. The shafts are all of large size, sunk and timbered in the best manner, and are completely equipped with powerful hoisting machinery. These shafts have about 20 miles of underground openings, the most extensive ever made in any new mine in the Lake district. Work was suspended early in 1901, ostensibly to await the completion of an addition to the Hecla mill, but it is not certain that the company would care to work the Osceola shafts with copper at 12 cents per pound.

Generally speaking, the richer parts of the conglomerate are toward the center of the mine, though some exceptionally rich ground has been found in No. 5 Calumet, the northernmost shaft. The southernmost shaft of the South Hecla or Black Hills portion of the mine has been put down to great depth, but has encountered little rich ground. To the north of No. 5 Calumet there is a considerable stretch of lean ground up to the north boundary.

Pillars 75′ wide are left on either side of every shaft, at the various levels. When the present conglomerate workings are exhausted down to the Tamarack line, which will be at a time variously estimated as 20 to 30 years, there will be millions of dollars worth of copper remaining in the pillars supporting the incline shafts. A conservative estimate is that 15% of the lode rock remains unmined in these pillars. This can be secured eventually, when the time comes to rob the old workings. The mine is opened for 8 to 10 years in advance, which is possibly too far ahead in such soft ground. The quantity of timber used in the mine is about 30,000,000′ annually, and many million feet of lumber are required on surface.

The incline shafts on the conglomerate are worked as two separate mines and are known as the Hecla and Calumet branches, the South Hecla being a southerly continuation of the Hecla branch. The shafts on the outcrop are as follows, from north to south: 6 and 5 Calumet, 2 compartments each; 4, one compartment; 3 and 1, abandoned; 2, one compartment; 1 Hecla, abandoned; 3, 4, 6, 7 and 8 Hecla, 1 compartment each; 9 and 10 Hecla, two compartments; 11 and 12 South Hecla, one compartment each and practically abandoned; 13, 14, 15, 16 and 17 Amygdaloid, on the Osceola lode, 2 compartments each; Red Jacket vertical, sunk to some distance west of the conglomerate outcrop to intercept the underlay, 6 compartments.

The older shafthouses and rockhouses have been replaced in the past few years, and shafthouses at the incline shafts are of uniform pattern. At each the rock is hoisted to the top of the shafthouse, thence passes over grizzlies that allow the finer rock to fall through, the larger masses being reduced in 2x3′ crushers of the jaw type. On the floor below there is an 18x24″ crusher. After crushing the rock falls by gravity into storage bins, whence it is dumped into hopper-cars that take it to the mills at Lake Linden, railroad tracks running underneath each rockhouse. The hoisting engines at these shafts are among the most powerful in the world, ranging from 1,000 to 8,000 horse power each. Miners are taken in and out of the incline shafts by man-cars, which are long trucks having tiers of circus seats, and replace the regular skips when needed, being quickly shifted on or off the skiptracks by powerful cranes. This proves the safest, cheapest and quickest method for moving men in and out of deep mines on incline shafts.

The Calumet & Hecla has suffered severely from mine fires in the past. Flames cannot burn the rock, as in sulphide ore mines, but attack the timbers and stop all work by smoke, as well as doing great damage by destroying the timbering and drawing the shafts. All timber placed underground is fireproofed with a zinc-chloride solution. Permission for visitors to go underground is secured with great difficulty, and can be had only from the president of the company. Previous precautions have been rendered more stringent during 1902, which has been an era of bad fires in big copper mines. Low prices for the metal always render copper mines more liable to "spontaneous combustion." An elaborate system of underground fire protection has been installed, including electric signal systems, water pipes, hydrants, hose, chemical engines, etc. A complete telephone system has also been installed underground and on surface, a private exchange being operated, with metallic circuits throughout, and having about 80 instruments connected with the long distance Bell system. The value of the company's elaborate system of guarding against and fighting underground fires has been questioned, but the experience of May, 1900, offers evidence that the money and thought lavished on the work were well expended. The Calumet & Hecla mine is the greatest single fire insurance risk in the world, and one on which no insurance company would place a dollar of indemnity, hence it devolves on the owners of the mine to furnish their own protection. The mine suffered heavy fire losses in 1887, 1889 and 1900. Three shafts were so badly damaged that they were abandoned, and there was also loss of life. When fire broke out in No. 3 Hecla shaft in May, 1900, the fire fighting system of the mine was given a severe test. The fire occurred on Sunday evening, when the mine was deserted except for a few employes, and had gained great headway before discovered. Fire doors were closed wherever possible, but the flames had gained such start that efforts to extinguish them with water or chemicals were useless. The burning portion of the mine was shut off by closing the fire doors, and as soon as possible thereafter the mine was sealed at surface by covering the mouths of the shafts with heavy timbers and tamping dirt tightly into the crevices between the beams. Wherever gas escaped through holes in the earth, dirt was tamped in and made solid with water. The fire was extinguished within three weeks, and the South Hecla portion of the mine continued working without interruption. No. 3 shaft was badly injured, but the fire would have done greater damage had it not been for the precautionary measures taken long before its outbreak.

In addition to underground fire protection, a fire department, modeled on metropolitan lines and having the latest apparatus, is maintained on surface. This affords protection to the mine buildings and location, and responds to calls from neighboring villages.

At No. 4 Calumet there is a wonderful group of the most powerful machinery ever built. The brick engine house, 62x146′, contains the Corliss engine "Superior," of 4,700 h. p., with 40″ cylinders and 70x72″ stroke, also the auxiliary engines "Baraga" and "Rockland," of 2,000 and 600 h. p. respectively; two Rand air compressors with capacities to run 25 and 40 drills, and the engine "Mackinac," a quadruple-cylinder triple-expansion steel giant of 7,000 h. p. There are four drums, 8½′ wide and 20½′ in diameter, which hoist from four different shafts, two of these drums carrying more than 1¼ miles of steel cable each. Power is supplied by batteries of boilers in two boiler houses adjoining, which have a brick chimney 250′ high and 12½′ inside diameter. Locomotives haul the coal into these boiler houses, which have automatic stokers. The engine "Mackinac" runs the air compressors for the Calumet branch. The old Leavitt compressor, nominally of 500-drill capacity, was inefficient, and could not feed air to more than 300 power drills at best. During 1902 the Leavitt compressor was replaced by three Nordberg engines, which are compressing air sufficient to supply 500 drills. In the Leavitt compressor water was injected into the compression cylinders, while the Nordberg machines deliver the compressed and greatly heated air to a cylindrical steel cooler, 12′ in diameter and 30′ high, into which water is sprayed from above and drawn off at the bottom, this cooling the air to 80° Fahrenheit—27° Centigrade. No. 4 Calumet shaft is about 6,900′ deep at the close of 1902 and will eventually reach a depth of 8,100′ on the incline, equal to about 4,900′ vertically, at the boundary line between the Tamarack and Calumet & Hecla.

The Hecla engine house is of brick, 47x80′ in size, flanked by a large boiler house, and contains the compound hoisting engine "Frontenac," of 2,000 h. p.; also two auxiliary engines of 600 and 900 h. p.; one Rand air compressor of 30-drill capacity and a pair of water-plunger air compressors with a combined capacity of 144 drills—the largest machines of this type ever constructed. South of the Hecla engine house is the engine house known locally as the "G. H. & S.," from the initials of its three engines, the "Gratiot," "Houghton" and "Seneca," of 2,000 h. p. each. The boiler house has five boilers and a stack 200′ high by 9½′ internal diameter. The "Gratiot" was remodeled and removed to the stamp mills at Lake Linden in 1902. Alterations were also made on the "Houghton" and "Seneca," which are now doing the work formerly performed by all three engines.

Next south is the engine house operating Hecla shafts 7 and 8, containing the engines "Hancock" and "Pewabic," each of 2,000 h. p., which operate drums of 25′ diameter, by means of spur gearing. The Leavitt 5,000 h. p. engine for the man-cars is installed at this point. A boiler house 50x120′ houses ten boilers and has a smokestack 250′ high by 12½′ internal diameter. Electric pumps were installed in No. 7 Hecla in 1902. Similar pumps have been in use in the Calumet branch for some years and are said to be giving efficient service.

Next south there are two engine houses, serving shafts 9 and 10 South Hecla, containing the engines "Detroit" and "Onota," of 1,000 h. p. each. The engine house at shafts 11 and 12 has engines of similar capacity.

The Red Jacket vertical shaft was started after the second fire, in 1888, and cut the lode at a depth of 3,287′. It is bottomed at the depth of 4,920′, from which point it will be possible to crosscut and intercept the conglomerate at its deepest point on the Calumet & Hecla tract. The rock temperature in the sump of the Red Jacket shaft, when first bottomed, was 87.6° Fahrenheit—31° Centigrade—very warm for labor. Since connection has been secured with No. 4 Calumet, by crosscuts, the temperature has been reduced to between 70° and 80° Fahrenheit. Exhaust air from the power drills aids in cooling the mine, which is decidedly warm, though by no means unbearable. The Red Jacket shaft was designed to open a mine unconnected with the older workings, to give reserve stopes in case of a mine fire. As the heat and danger were so great, connection was made with the older shafts and in consequence the shaft is a failure, so far as being immune from fires in other parts of the mine. The conglomerate lode at this point is not up to its usual value, being wide and considerably below the Calumet & Hecla average in copper contents.

The surface equipment at the Red Jacket shaft includes a quadruple hoist of 8,000 h. p. in a brownstone building of 70x220′. In an adjoining brownstone building of 70x150′ are ten 1,000 h. p. boilers. At the rear of the engine house is a brownstone annex, floored with cement and roofed with slate, 32x412′, in which is carried the fleet-gear. In raising ten-ton loads perpendicularly from a depth of nearly one mile, the weight of the cage and steel cable nearly equals that of the cargo of rock. With the aid of a counterbalance, the engines hoist ten-ton loads at forty miles an hour, the hoisting time being about 90 seconds for the vertical distance of nearly a mile—this allowing for starting and stopping. No locomotive could duplicate the record on a horizontal plane. The combination shafthouse and rockhouse at the Red Jacket vertical is of steel throughout, fitted with breakers capable of handling 1,000 to 2,000 tons of rock daily. The smokestack of the boiler house is 250′ high, with an inside diameter of 12½′. The capacity of the shaft is being greatly increased by automatic self-dumping skips swung under the cages. These will enlarge the daily hoisting capacity to 2,000 tons or more. The Red Jacket shaft is to have the largest air compressor ever built, the order having been placed in 1901. This will be a vertical duplex compound Riedler, of Allis-Chalmers make, driven by a vertical compound condensing King engine. Each section will compress 14,000 cubic feet of free air per minute to a pressure of 70 lbs. per square inch, giving capacity to furnish power for 275 drills each, or 550 drills for the duplex machine. This monster compressor will cost $350,000 with foundations, without boilers or building.

The surface equipment of Calumet & Hecla is the most complete to be found at any mine on the globe. With rare exceptions, everything is duplicated, to prevent delays or suspension being caused by fires or accident. The carpenter shops are of great size and fitted with every modern woodworking appliance. The smithies are larger than may be found elsewhere outside of the works of a few of the very largest machinery manufacturers, and are supplied with steam hammers, forges, blowers, emery wheels, grindstones, etc. These shops sharpen upwards of fifty tons of steel drills daily, requiring the services of a small regiment of drill boys for transport between the shops and mines. The main machine shop is 225x250′, and employs more men than any machine shop in the city of Boston, a town that, with its immediate suburbs, numbers considerably more than a million people. The machine shop is very complete in equipment and can turn out an astounding variety and quantity of work. The only possible accessory lacked by the Calumet & Hecla is a foundry, and this lack is not felt because of the proximity of three large and modern foundries, operated by private enterprise. The company has a very large brick warehouse for general supplies, and special warehouses for steel and iron, etc., all having direct connection with the Hecla & Torch Lake Railroad, which is a private line, operated by the company, connecting the mine, mill and smelter, and has some 20 miles of spur tracks and sidings that reach every shaft, shop, warehouse and mill. The road has big locomotives and a large equipment of rolling stock, though its cars are not of as large size as might be desired.

There is a timber mill that mortises and tenons the bed-pieces, legs and stulls of the square sets used underground. There is a large paint shop, also oil-houses, barns, etc. The electrical building is 74x74′, of stone. Electric light is used in all mine buildings and throughout the mine location, and electric power is furnished for many of the pumps used underground.

The company owns about 1,200 houses, rented to employes at an average of 6% interest, plus actual cost of maintenance, and upwards of 1,000 dwellings are owned by employes on lands leased from the company at low yearly rentals. A large and well-maintained hotel is also owned.

In the way of religious, educational, social and medical advantages, the Calumet & Hecla has always evinced a most generous desire to aid its employes and their families. There are some 30 churches on the company's lands, occupied by a dozen different denominations. For all of these the sites have been donated, and in most cases other substantial aid has been given in erection and maintenance. There are also eight schools on its lands, most of which were built by the corporation. There is a large stone clubhouse for employes, containing bathrooms, bowling alleys, etc. A free library of about 16,000 volumes is maintained at the mine, and contains books printed in more than a score of languages, thirty different nationalities being represented on the company's pay-roll. A club and library building is also kept open at Lake Linden, for employes of the mills and smelters.

The company maintains a hospital, for employes solely. The new hospital, built in 1898, is noted for its complete surgical and laboratory apparatus. Nearly a dozen physicians are on the staff and are at the call of any employe requiring medical or surgical aid. Early in the mine's history an aid fund was instituted for employes, and is managed by directors chosen by the workmen. This fund pays death and disability benefits, enormous sums having been disbursed in the past 30 years, every dollar going to the sick and injured, or to the families bereaved of their breadwinner by accident or disease. The surplus moneys accumulated in this fund have been invested in the company's shares, bought on the open market. The disbursements from this fund, which is controlled by the employes themselves, were $66,489.70 for the year ending Apr. 30, 1902, and the value of the fund, at cost price of stock held, which is considerably less than the market value, was $136,234.80.

The Calumet & Hecla maintains three separate systems of waterworks, one at Lake Linden and two at Calumet. One of the latter furnishes water from dams for fire protection; the other pumps potable water from Lake Superior, four miles distant. The pumps at the Lake Superior plant are capable of raising about 4,000,000 gallons daily to the mine location, 600′ above the lake. At the dam and mine there are seven pumps, with a combined daily capacity of upwards of 45,000,000 gallons.

The stamp mills are located at Lake Linden, four miles from the mine, on a tract of about 1,000 acres, including several miles of frontage on Torch Lake. There are two wooden mills, the "Calumet" and "Hecla," each of which originally had 11 Leavitt steam stamps with cylinders 14x21½″ and 24″ stroke. An addition to the southern end of the "Hecla" mill was completed in 1902. This is 165x308′, of steel, built by the American Bridge Co. It is being fitted with 6 stamps, each run by an independent 25-h. p. electric motor. Chilean mills are to be used for regrinding the coarse sands from the stamps, preliminary to rejigging. The mills have jigs, slime tables, Wilfley concentrators and a Robbins conveying belt. Water for washing the crushed rock is furnished by 5 pumps, of which the pumping engine "Michigan," housed in a separate building, is the most powerful in the world, having a daily capacity of 60,000,000 gallons. The engines "Huron" and "Ontario" have 20,000,000 gallons daily capacity each, the "Erie" 10,000,000 gallons, and an I. P. Morris pump at the new mill can supply 22,000,000 gallons per diem.

The mills stand on the flat western shore of Torch Lake, at little elevation above water level. Tailings speedily filled the shallow lake for some distance off shore, and to waste the sands it became necessary to elevate them to a considerable height. This is done by sand-wheels. The conglomerate rock entering the mill leaves as coarse sand, to the extent of nearly 6,000 tons daily. This is washed through launders to the sandhouse, where it is scooped up by the buckets of the wheels and dumped high above into launders running on trestles far out into the lake, these spouting forth minature Niagaras of brick-red color from their ends. An addition to the sandwheel house was built in 1902, of steel, 65x78′ on the ground and 94′ high, with three floors. This is an annex to the old wheelhouse, which is of frame, iron-sheathed. The steel in the new structure weighs 490 tons, and the building is equipped with a 45-ton Sellers traveling crane. The sandwheels are of 40′, 50′ and 60′ diameter. The largest, installed in 1902, is to appearance a gigantic bicycle wheel, fitted with a spur gearing where the rubber tire should be. The completed wheel weighs 5,000 tons, and is mounted upon massive concrete masonry. Four iron bed-plates, of 25 tons each, support the pillars carrying the axle, which was forged by Krupp, in Germany, and weighs 21 tons. The shaft is 27′ long and 32″ in diameter, with a hollow core of 26″ diameter. Radiating from axle to rim are steel spokes 32′ long and 2″ in diameter. The rim is in 20 segments, weighing 10,700 lbs. each. On the perimeter are 550 buckets, in pairs, each 3′ wide and 4′ 6″ long. These hold 100 gallons each, giving the wheel a capacity of 55,000 gallons per revolution. The completed wheel is 10′ wide and 60′ in diameter, and is driven by gear and pinion, power being furnished by a 700-h. p. dynamo.

The electric power plant for the mill is in a steel building just west of the Hecla mill, erected in 1902. This is 45x85′ with a wing 45x60′ and houses two engines, the "Gratiot" and "Saginaw." The "Gratiot," from the G. H. & S. engine house at the mine, has been remodeled, and is connected with the generator by rope belting. The new Allis-Chalmers "Saginaw" is a twin vertical tandem compound expansion engine, having cylinders 17x40x48″, with speed of 95 revolutions, and direct connected. Each engine drives a 1,000-kilowatt alternating current generator. This plant furnishes energy for the sand wheel, new Hecla mill, electric lights and miscellaneous uses.

At the stampmills and smelters there is a large number of miscellaneous buildings, used for shops, warehouses, etc. The new boiler house and smithy is of steel, 50x100′.

The tailings at the Lake Linden mills are the most extensive in the world, containing upwards of 25,000,000 tons of stamp sand, which carries copper from about 0.5% in the newer parts up to nearly or quite 1% in the older sections. The total amount of copper in these sands is between 150,000 and 200,000 tons. Experiments in reworking the sands have been conducted recently by Todd C. Woodworth, using the Taylor-Woodworth automatic slime system. The tests have given good results and it is planned to install a concentrating plant of about 2,000 tons daily capacity for reworking the old sands, and if a success, the capacity will be increased.

The Calumet & Hecla reduces its own mineral to copper, having smelting plants at Lake Linden and Buffalo. The former works were opened in 1887 and have since been greatly enlarged, now covering the major part of the 30-acre tract occupied, this lying about a mile south of the stamp mills. There are four furnace buildings, each 80x130′, a blister copper furnace building 50x70′; warehouse, laboratory and assay office, machine shop, boiler house and 3 mineral houses having a combined storage capacity of 18,000 tons. The mineral, or crude copper, comes from the mills carrying about two-thirds metal to one-third gangue rock. This is a lower percentage of copper than formerly, but is due solely to the evolution of improved means of milling and smelting that render it possible to save and smelt the very fine copper formerly lost in the tailings. The mineral is dressed to a lower percentage, but the proportion of the total value saved from the rock is higher than ever before. The furnaces are of the reverberatory type, except the cupolas for making blister copper, and have been rebuilt and greatly enlarged during and since 1900. The increased capacity has been found highly economical. The new reverberatories have 93′ stacks, and are top-charged, the mineral being thoroughly dried on platforms above the furnaces before charging. The largest blast furnace is 40x96".

The eastern plant is known as the Buffalo Smelting Works, at 1 Austin St., Buffalo. These works are located on the Niagara River, at Black Rock, with deep water in front and direct rail connections in the yards. The plant was established in pursuance of the company's policy of duplicating every vital part of the mine, mill and smelter, and has grown rapidly, entirely covering the original tract, to which new ground was added in 1901. A modern electrolytic plant was completed in 1902, and is working well. This reduces certain grades of mineral carrying considerable values in native silver. A new wharf on the Niagara river was completed in 1902.

Sufficient mineral is shipped during the season of lake navigation, April to November, to keep the Buffalo works running full time for the year. The higher grade mineral goes east for smelting, thus saving freight charges. The company owns and operates a fleet of steel steamers and barges for carrying down mineral, soft coal being brought as return cargoes. There is a series of very large coal sheds at Lake Linden, one of which has 200,000 tons capacity. The old sheds are of wood, the new ones of steel. There is also a series of docks on Torch Lake, at the mills and smelts, all with substantial wharves and having at least 21' of clear water alongside. Frequent dredging is required to clear out the stamp-sand that fills in. The Calumet & Hecla owns and operates a ship canal, connecting Torch Lake with the government waterways on Portage Lake. This canal is 21' deep and accommodates the largest vessels plying the great lakes. Tolls ranging from 10 cents on soft coal to 50 cents per ton on package freight are charged on cargoes entering Torch Lake through this canal.

Near the mouth of the Trap Rock river, at the head of Torch Lake, is the sawmill, built in 1901. This is a strictly modern plant and saws logs towed to it in rafts. There is water on one side and the company's railroad on the other, permitting economical handling of raw and finished material. The company also owns and operates a sawmill on Whitefish Point, Chippewa County, Mich., and owns extensive tracts of pine, hemlock and hardwood at various points along the southern shore of Lake Superior.

Articles intended to describe the Calumet & Hecla are printed almost daily in various publications of the civilized world. A very few of these are accurate, but the majority are ludicrously erroneous. No corrections of such mistaken descriptions are ever made by the mine's management, which ignores both flattery and abuse. Nobody has ever received a penny for printing or refraining from printing any sort of matter, good, bad or indifferent, regarding this property or its management.

The Calumet & Hecla management is open to criticism for some of its expenditures in the past, but is now making a praiseworthy effort to economize wherever economy can be enforced without degenerating into niggardliness. Useless machinery has been bought in the past, at heavy expense, but the Calumet & Hecla has led the world in mining machinery for three decades, and its example has been potent in bringing about the leadership of Lake mines in mechanical equipment. The reports to shareholders are exceedingly meagre, and should be more detailed, but there is no question of the absolute honesty of the management. It would be better if shareholders were given some particulars regarding the operation of their mines, but the giving of such details would not increase the dividends. The company is autocratic with its employes, in some ways, but no corporation ever did more for its men, and the loyalty of the great mass of Calumet & Hecla employes to the corporation is like the loyalty of good soldiers to their flag. This feeling of confidence extends beyond the men on the pay-roll. A community of nearly 40,000 souls has grown up about the mines, and the incorporation of this mining camp under a city charter would offer many advantages to the business interests and townspeople, but the company doesn't want a city made of Calumet and that settles the matter. The nearly universal feeling at Calumet is that "the company" will do the right thing by everybody, and that no matter how desirable a thing may seem, attempts to secure it are barred by the company's veto. This attitude is not caused by servile obedience to corporation mandates, but is begotten of a confidence based on more than thirty years of just and generous dealings.

While the Calumet & Hecla management is not infallible, it must be remembered that this company has been a pioneer in many fields. It has made some unwise expenditures, but has paid the largest profits of any mining company ever organized; it has given an imperial revenue to its owners, yet has paid the highest wages to its employes; its copper has been sold to the best advantage, yet it has always protected the interests of its customers; it might have paid larger dividends, but the fact remains that the dividends that have been paid are the largest ever disbursed by any mining company. It is easy to criticise, but the critic that studies this mine and its management at close range will draw it mild, for he will find very much in the conduct of the Calumet & Hecla that will appeal strongly to his sympathy, if he be a lover of his fellow men, and a believer in the duties as well as the privileges of wealth.

**CALUMET & MONTANA DEVELOPMENT CO. MONTANA.**

Former office: Calumet, Mich. Out of business.

**CALUMET & PITTSBURG COPPER CO. ARIZONA.**

Office: Calumet, Mich. Mine office: Bisbee, Cochise Co., Ariz. Capitalization $400,000, shares $10 par. Chas. Briggs, president; John S. Dymock, vice-president; Peter Ruppe, treasurer; Gordon R. Campbell, secretary. Property, 19 claims, in the Warren mining district of Cochise Co. Is developing; shaft 900′ deep; indications at close of year are highly favorable to the speedy discovery of a good ore body; will begin drifting just below water level.

**CAMBRIAN COPPER MINING CO., LTD. WALES.**

Property is the Caerwych mine, at Caerwych, Merionethshire, Wales. H. B Edwards, chairman; G. D. Crawford, secretary. Capital, nominal, £60,000; issued, £20,007. Letter to the company returned unclaimed, October, 1902, from former address, 11 Queen St., London, E. C., England.

**CAMBRIAN MINING & MILLING CO.** **CALIFORNIA.**

Lands, about 10 miles from Placerville, El Dorado Co., Cal. Employs 20 men. F. Thomas, president; Leonard Thomas, general manager; D. R. Roberts, superintendent. Mine has 3 parallel veins, averaging 6′ to 8′ wide, with gangue of talcose schist and lime, between diorite and serpentine. Has considerable underground development. Ores are cuprite, malachite and sulphides, with native copper in the alteration zone, ores carrying 8% to 16% copper and considerable gold.

**CAMOS MINING CO.** **IDAHO.**

Has gold-copper claims near Doniphan, Blaine Co., Idaho. A. J. Borrall, manager at last accounts. Letters to company returned unclaimed

**CAMP VERA GROUP.** **CALIFORNIA.**

In the Morrow district of San Bernardino Co., Cal. Owned by J. W. Rodgers, Barstow, Cal.

**CAMPANARIO GROUP.** **SPAIN.**

Address: care of Don Antonio Guijarro, Orta, Huelva, Spain. Mines, at Valverde del Camino, Huelva, consist of a group of six properties, area 47 hectares, on which iron-copper sulphides are being developed.

**CANADIAN COPPER CO.** **ONTARIO.**

Office: 12 Wade Bldg., Cleveland, Ohio. Stock issue owned by the International Nickel Co. The mines of this company, at Copper Cliff and Sudbury, Algoma, Ontario, are the world's largest producers of nickel, and incidentally furnish a large amount of copper as a by-product. The discovery was made in 1882 and the Copper Cliff mine was opened in 1886. The principal mines of Canadian Copper Company are the Copper Cliff; the Stobie, located in Blezard Twp., 4 miles north of Sudbury; Evans; McArthur 1 and 2; Clara Bell A and B; McDonald, and others. The deepest mine is the Copper Cliff, 1,000′ and the main plant is located there. Ore bodies occur as irregular lenses of nickeliferous chalcopyrite with a pyrrhotite gangue, in basic igneous rocks, mainly greenstone and diorite. Ore is heap-roasted and matted at the mine, matte being shipped to the Orford Works, at Constable's Hook, N. Y., for refining. Ore treated gives average returns of about 2½% nickel and 2¾% copper, with an annual production of 4,000,000 to 7,000,000 lbs. refined copper.

**CANANEA CONSOLIDATED COPPER CO.** **MEXICO.**

This is the company, incorporated under the laws of Mexico, that holds title to the Greene Consolidated mines. For further particulars see Greene Consolidated.

**LA CANANEAS COPPER CO.** **MEXICO.**

Former office: Real Estate Trust Bldg., Philadelphia, Pa. Mine office: La Cananea, Sonora, Mexico. Capitalization, $5,000,000, shares $5 par. Fredk. A. Trittle, president; Chas. D. Cramp, vice-president; Ehud N. Darling, secretary and treasurer. Claims to own La Libertad and El Ultimatum mines, adjoining Greene Consolidated. Letter to company's address returned unclaimed, December, 1902.

**CANDELA MINE. MEXICO.**

A developing property, in the state of Michoacan, Mexico. Is understood to be opening a large body of low-grade sulphide ore.

**CANDELARIA MINING CO. MEXICO.**

Office: El Paso, Texas. Mine office: San Pedro, Chihuahua, Mex. Britton W. Davis, president; David B. Smith, superintendent. Operates the Candelaria, Congreso, San Nicolas and other mines, producing gold, silver, lead and copper, the latter in small quantities, as a by-product. Main shaft, 900′; tunnel, 800′. Steam and electric power; concentrator and smelter. Employs upward of 1,000 men.

**CANDELARIA MINING & EXPLORATION CO. MEXICO.**

Office: Colorado Springs, Colo. Mine office: Parral, Chihuahua, Mexico. H. L. Browne, manager. Ores carry gold, silver, lead and copper. Has 150′ shaft and 175′ tunnel. Steam power; 5-stamp mill; 25-ton cyanide plant. Employs about 40 men.

**CANON COPPER CO. ARIZONA.**

It was intended in October, 1902, to organize a company by this name, to purchase the Cameron Mines, in Coconino Co., Arizona, for $35,000.

**CANTON COPPER MINE. GEORGIA.**

An old property in Fannin Co., Georgia, owned by H. B. Rich, now in process of reopening. Had one shaft, about 300′ deep, in July, 1902. Ore is found as a micaceous schist strongly impregnated with chalcopyrite.

**CANYON GOLD & COPPER CO. MONTANA.**

At Canyon Ferry, Lewis & Clarke Co., Mont. A. W. Martin, superintendent. Was driving a tunnel, with a small force, at last accounts.

**CANZA MINE. PERU.**

An old property, once a considerable producer, located 12 miles from Ica, Peru, 4,000′ above sea level. Numerous cupriferous veins in igneous rocks carry bodies of ore that are sulphides below the water level and oxides and carbonates in the alteration zone. There are three main veins, with openings to a depth of 700′ on the Adelaide; 1,000′ on the Consolador and 500′ on the Tapadita, the latter having been the principal producer.

**CAP SHEAF COPPER & GOLD CO. BRITISH COLUMBIA.**

Supposed to have prospects on Texada Island, B. C. No returns secured.

**SOCIETA DELLE CAPANNE VECCHIE E POGGIO BINDO. ITALY.**

Mines at Massa Maritima, Grosseto, Italy. These are old mines, and were reopened in 1846, since when they have been steady producers. Ore is mainly chalcopyrite, of fair average values, and the general conditions of geology, etc., are the same as at the other mines of this district.

**CAPE COPPER CO., LTD. CAPE COLONY, NEWFOUNDLAND & NORWAY.**

Offices: 9, Queen St. Pl., London, E. C., Eng. E. A. Pontifex, chairman; John Taylor & Sons, managers; J. L. Dean, mine manager; P. J. Franks, secretary. Capital, nominal, £750 000, in 75,000 cumulative 6 per cent. preference and 300,000 ordinary £2 shares; issued, £690,000. Dividend pay-

ment, £224,250 in 1901. Company holds Tilt Cove mine, in Newfoundland, on 99-year lease from 1890, at annual rental of £4,400 and one-half of net profits. Gross profit from this property in 1900 was £66,349. The East mines of the Tilt Cove give a sulphide ore returning 3% to 3½% copper, with some gold and silver, while the West mines average 11% copper, but have much smaller ore bodies. Company is also interested in sundry Norwegian mines and is entitled to one half the profits of the Briton Ferry Chemical & Manure Co., Ltd., which takes the sulphurous gases given off from the smelters of the Cape Copper Company's works at Briton Ferry, Eng. The principal mines of the company are near O'okiep, Little Namaqualand, Cape Colony, South Africa. These properties include the O'okiep, Nababiep, Narrap, Spektakel and other mines. The O'okiep mine was opened in 1852, as was also the Spektakel. The Nababiep was opened circa 1890 and gives about 7% ore. The Narrap is a new property, in course of development. The ore is matted at the O'okiep smelter to a tenor of about 48% and shipped to the English works for refining, through Port Nolloth. The Namaqualand smelters have lately been considerably enlarged. The Spektakel mine has recently been reopened and is being thoroughly explored, with prospects of again becoming an important producer. Operations for 1901 show an actual loss of about £6,000, owing to a variety of unfortunate circumstances, including the fall in the price of copper and the South African war. Company is an important producer and has long been managed with great prudence, fidelity and success.

**CAPE BRETON COPPER CO., LTD. NOVA SCOTIA.**

Office: 53 State St., Boston, Mass. Mine office: Coxheath, Cape Breton Co., Nova Scotia. Capitalized at $2,000,000. John C. Watson, president; Isaac P. Gragg, secretary. J. Dorr, treasurer. Directors are preceding officers, A. M. Cuniff, Harry H. Gay and Chas. A. Hale. Property is the old Coxheath mine and adjoining lands, Cape Breton, N. S., showing several cupriferous veins, of which the principal traverses felsite and diorite, having an average width of 10', carrying argentiferous and auriferous chalcopyrite, in a silicious gangue, and containing about 4½% copper.

**CAPE D'OR COPPER DEVELOPMENT CO. NOVA SCOTIA.**

A company by this name has been operating at Cape d'Or, Cumberland Co., N. S., but furnished no returns in response to requests.

**CAPILLITAS COPPER CO., LTD. ARGENTINA.**

Offices: 6, Princes St., London, E. C., Eng. G. Grinnell-Milne, chairman; N. Brown, vice-chairman; J. G. Tait, secretary; J. G. MacArthur, consulting engineer. Capital, nominal, £600,000. Property, copper mines in the Capillitas and Atajo districts, province of Catamarca, Argentina, also 50,000 hectares of timber land and the Pilciao and Constancia smelters, about 30 miles from Capillitas. Ores said to average 23% copper and to carry both gold and silver in small quantities. Smelters contain 8 reverberatory furnaces. Properties of this company are rich and apparently of great value. The mines have been worked on the most limited scale and under the most disheartening difficulties by previous owners. The present company is introducing modern methods as rapidly as possible.

**CARBONATE & LAURA MINES.** **COLORADO.**

At Crystal, Gunnison Co., Colo. Employ 20 men. Hoffman Bros., owners. Ores carry gold, silver and copper; mine supplied with water power and opened by shaft and tunnel.

**CARDENAS COPPER CO.** **ARIZONA.**

Absorbed by the Anita Consolidated Copper Company of Arizona.

**CARDENILLO & EL ARMADILLO MINES.** **MEXICO.**

At Tuxpan, Tepic, Mexico. Employ 100 men. Fernando Diaz, owner; A. C. Gonzales, manager. Mines are opened by shafts and equipped with steam power; ores carry copper and silver.

**CARIDAD MINE.** **SPAIN.**

Located near Sevilla, Spain. Don Carlos Lacone, agent. Owners are now developing bodies of chalcopyrite and iron pyrites.

**CARIDAD COPPER MINING CO., LTD.** **SPAIN.**

Offices: 20-21, Lawrence Lane, Gresham St., London, E. C., Eng. Mines, at Campopio, Huelva, Spain. Organized February 15th, 1899. Capital, nominal, £350,000; issued, £75,492. R. S. Simpson, chairman; G. Thompson, secretary; R. T. Swallow, general manager. Property, 208 acres, at Lazoyuela, Madrid, Spain, and 465 acres at Campopio, Huelva, Spain, including the Caridad, San Antonio and Descuido mines.

**CARISA COPPER & GOLD MINING CO.** **UTAH.**

Office: Salt Lake City, Utah. Mine office: Mammoth, Juab Co., Utah. A. J. Underwood, superintendent. Operates the Carisa and Spy mines, primarily gold and silver properties but carrying considerable copper and lead as by-products.

**CARLISLE COPPER CO.** **MONTANA.**

Organized as successor to the Butte-Anaconda Company, which did some development work on the Carlisle mine in East Butte; letter addressed to company at Butte returned unclaimed, October, 1902.

**CARMACK GOLD & COPPER MINING CO.** **WASHINGTON.**

Office: 124 Pike St., Seattle, Wash. Mine office: North Bend, King Co., Wash. Organized 1899, with capitalization $500,000, shares 25 cents par. G. W. Carmack, president; L. O. Lane, secretary; W. J. McConnell, treasurer. Lands, 5 claims on south fork of Snoqualmie river 22 miles southeast of North Bend. Has 375′ of shafts and tunnel, showing 3 veins of 1′, 2½′ and 12′ carrying fair values in gold, silver, lead and copper.

**CARMEN COPPER MINES, LTD.** **CHILE.**

Offices: St. George's House, Eastcheap, London, E. C., Eng. Mines at Cerro Blanco, Copiapo, Chile, including the famous Carmen Bajo group. Company registered, June 28th, 1900. Capital, nominal, £125,000; issued, £75,307. E. A. J. Goldschmid, chairman; J. Peters, secretary and London manager.

**CARN BREA & TINCROFT MINES, LTD.** **ENGLAND.**

Offices and mine: Carn Brea, R. S. O., Cornwall, Eng. F. Harvey, chairman; J. Trevethan, secretary; W. T. White, mine manager. Owns tin and copper mines, at Redruth and Illogan, Cornwall, which once made nearly 1,000 tons of copper annually; secretary reports that present production of copper amounts in value to no more than about £800 yearly.

**GEORGE E. CARNE Y OTRO.** **CHILE.**

Own the Buena Vista mine, in the department of Tocopilla, Chile. Property opened 1880; idle at last accounts.

**CAROLINA COPPER CO.** **NORTH CAROLINA**

Office: 15 Atwater St. West, Detroit, Mich. Mine postoffice: Cullowhee, Jackson Co., N. C. Property idle. Organized 1901, under laws of Michigan, with capitalization $2,500,000, shares $25 par. Lewis C. Waldo, president; Hugh M. McCormick, secretary and general manager; Wm. B. Cody, treasurer; Wm. H. Ashwell, superintendent. Lands, about 1,000 acres, in Blue Mountain district of Jackson Co., showing 4 fissure veins, one of which is estimated by company to average 27′ width, 1,800′ length and 400′ depth, assaying 3% copper, with small gold and silver values. Ores, exclusively sulphides. Shaft, 55′; tunnel, 124′. Company contemplates resuming work in 1903 and is considering installation of Garretson pyritic smelter. Principal property is the old Wayehutta mine, having a 5′ to 8′ vein, carrying carbonate and silicate ores at surface and chalcopyrite at depth.

**EL CARPIO MINE.** **SPAIN.**

Located at Cortegana, Huelva, Spain; contains 11 old shafts, area 73 hectares, and is being reopened and developed by a French exploration company. Ores are iron-copper sulphides.

**CARP LAKE MINING CO.** **MICHIGAN.**

Office: 12 Maiden Lane, New York. Lands, in Porcupine Mountain district, Ontonagon Co., Mich. H. L. Payne, Cleveland, Ohio, general manager. Area, 1,087 acres. Work begun 1858, by shafts and adits; one adit 1,250′. Had a mill with 20 gravity stamps, at one time. Lode about 7′. Has had some exploratory work in the past few years. Fully described in 1902 issue.

**CARR MINE & COLORADO CO., LTD.** **COLORADO.**

Near Black Hawk, Gilpin Co., Colo. Stephen Hoskin, manager. Primarily a gold and silver mine, securing copper and lead as by-products. Steam and electric power; 100-stamp mill; employs 60 to 75 men.

**MINAS DE CARRACEDO.** **SPAIN.**

Office: Bilbao, Viscaya, Spain. Mines, in process of development, are in the Province of Palencia, Spain.

**CARRERAS HERMANOS.** **BOLIVIA.**

Office and mine: Coro Coro, La Paz, Bolivia. Mine is opened on two successive strata of cupriferous conglomerates; see article on Bolivia for details. Product, about 400 tons of 75% copper mineral yearly. Only native copper is mined, and the product, as barillas de cobre, is shipped through Mollendo, Peru, for refining.

**SOCIEDAD DE MINAS Y FUNDICIONES DE CARRIZAL.** **CHILE.**

This company operates the Chanarcitos mine, in the department of Freirina, Chile, opened in 1857 and making about 1,800 tons of copper yearly. Also owns the Bronces mine, 408′ deep, opened in 1881 at Jarillas Transito, Vallenar; the Amarilla, 417′ deep, opened in 1867, at Cerro Blanco, Chanarcillo, Copiapo; Astillas, 260′ deep, opened in 1878, and the Armonia and Santa Margarita mines of the famous Carrizal Alto group, at Carrizal Alto, Freirina, Atacama. Company has a smelter at Chanarcitos and ships its production as a 45% to 50% matte. Its ores average 12% to 15%, as brought to the smelter.

**CARRIZAL SHARE TRUST, LTD. CHILE.**

Offices: 19, Birchin Lane, London, E. C., Eng. Owns stock in the Sociedad de Minas y Fundiciones de Carrizal.

**CARTER COPPER CO. VIRGINIA.**

Office: 11 Broadway, New York. Mine office: Trout Dale, Va. Company will change its name, January, 1903, to Manassas Gap Copper Mines. Employs 20 men. Organized 1901, under laws of New York, with capitalization $1,000,000, shares $1 par. H. L. Carter, president; John S. Wise, vice-president; Wm. Lawrence Clark, secretary; Geo. Brown Wright, treasurer and general manager. Directors are preceding officers, Lionel H. Leadam, Henry P. Porter, Powhatan Weisiger, Dr. Arthur L. Root and Walter T. Searing. R. R. Crook, mill superintendent. Lands, 700 acres, show 4 fissure veins with average width 5′ and average value 5% copper and 5 oz. silver per ton, from oxide, carbonate and sulphide ores. Shafts 28′ to 56′. Tunnels 43′ and 151′. Will install steam plant, March, 1903, and continue underground development. Contemplates installation of smelter and estimates 1903 production at 1,000,000 pounds. Has no bonded or other indebtedness.

**GUILLERMO CARVALLO. CHILE.**

Operates the Fundicion de Llaillai mine, in the Department of Quillota, Chile. Mine opened 1900, and makes equivalent of 500 tons of fine copper yearly, shipped as matte.

**CASCADE COPPER MINING CO. WYOMING.**

Office: 1246 Marquette Bldg., Chicago, Ill. Mine office: Encampment, Carbon Co., Wyo. Jas. Barrell, president; H. H. Rand, vice-president; Jas. Jay Smith, secretary and treasurer; Hiero B. Herr, general manager. Property is developing. Company declined to furnish statement for this work.

**CASTELLANOS Y COMPANIA. CHILE.**

Operate a small mine in the department of Combarbala, Chile; produce about 75 tons of bars and matte yearly.

**CASTREJON HERMANOS. MEXICO.**

Are operating or developing copper mines in the Huacana district of Ario, Michoacan, Mexico, according to the reports of the Mexican Minister de Fomento. No direct returns secured.

**CATALINA COPPER MINING CO. ARIZONA.**

Office: 15 Congress St., Boston, Mass. Mine office: Tucson, Pima Co., Ariz. Chas. H. Rollins, treasurer; Robert Johns, superintendent. Lands, 280 acres, carrying one mile outcrop of vein, in Santa Catalina Mountains, near Tucson. Developments are on Silver Reef claim, showing sulphide ore vein 8′ to 12′ wide, with assays 5% to 7% copper and $3 to $5 gold and silver per ton. Opened by 300′ tunnel and 300′ of drifts.

**SOCIETE DES MINES DE CUIVRE DE CATEMOU. CHILE.**

Offices: Boulevard Haussman, 50, Paris, France. Mine office: Catemu Las Maquinas, Putaendo, Chile. Operates El Cobre de Melon mine in the department of Quillota, Chile, opened 1866, and producing about 150 tons copper yearly; Nilque mine, opened 1866, in the department of Putaendo, making about 500 tons yearly, and Maquinas de Catemu, also in the department of Putaendo, opened 1870, and producing about 125 tons yearly. The output of the mines is shipped to Swansea as matte. Company also owns the Mantos mine, opened 1820; the Salado, opened 1841; the Esmerelda, opened 1860, and the Soldado, all developed by tunnels.

**CATARACT COPPER MINING CO. MONTANA.**

Has 7 claims on Basin Creek, Jefferson Co., Mont. Attempts to secure post-office address unsuccessful.

**CATARACT COPPER MINING CO. WYOMING.**

Office: 1246 Marquette Bldg., Chicago, Ill. Mine office: Encampment, Carbon Co., Wyo. Organized under Wyoming laws, with capitalization $1,250,000, shares $1 par. Jas. Barrell, vice-president; Jas. Jay Smith, secretary and treasurer. Lands, 124 acres. Has several shallow shafts. Company withholds detailed reports, but states that treasury stock is all placed and mining developments satisfactory.

**CAUCASUS COPPER CO., LTD. RUSSIA.**

Offices: 3, Princes St., London, E. C., Eng. Registered Oct. 4th, 1900, with capital, nominal, £500,000; has copper and silver-lead mines at Dzansulski, in the Caucasus. No returns secured.

**MINA DO CAVEIRA. PORTUGAL.**

A new mine, in process of exploration and development; not yet a producer. Located at Grandola, Portugal; owned by Crookson & Hawkins.

**COMPANIA MINERA EL CEDRO. MEXICO.**

At Guanajuato, Mexico. Vincente Gonzales, manager. Opened by shafts and equipped with steam power; product is gold and copper. Employs about 50 men.

**CENTENNIAL MINE. COLORADO.**

At Georgetown, Clear Creek Co., Colo. David Kennedy, owner and manager. Has gold-silver-copper ores, with steam power, and was producing a limited amount of high-grade ore in 1902.

**CENTENNIAL COPPER MINING CO. MICHIGAN.**

Office: 60 State St., Boston, Mass.; mine office, Calumet, Houghton Co., Mich. Is developing, with a large force. Company reorganized, with present title, under Michigan laws, in 1896. Capitalization, $2,500,000, in 100,000 shares, par $25. Annual meetings in April. H. F. Fay, president; W. B. Mosman, secretary; Geo. G. Endicott, treasurer; H. F. Fay, John C. Watson, W. B. Mosman, Wm. Howell Reed, Stephen R. Dow, Geo. G. Endicott and Jas. Chynoweth, directors; Jas. Chynoweth, superintendent; John Pentecost, mining captain.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount of cash paid in on capital stock | $1,150,000.00 |
| Entire amount invested in real estate | 249,657.00 |
| Amount of personal estate | 370,663.50 |
| Production of copper, 1901, in pounds | 806,400 |

The Centennial tract is Section 12, Town 56 North, Range 33 West, giving one square mile lying next north of the Calumet & Hecla, also a triangular patch of about 20 acres at the southeast corner of the main tract, bought to give the outcrop of the Kearsarge lode. The first work on the Centennial was done in 1863, by the Schoolcraft Mining Co. Efforts by that company to develop a paying mine on the northern extension of the Calumet conglomerate were unsuccessful, and the company was reorganized in 1876 as the Centennial Mining Co., and again reorganized in 1896 under the present title. Upwards of $1,500,000 have been expended in unsuccessful efforts to open a paying mine on the conglomerate. Seven shafts were sunk on this bed, three of considerable depth, No. 3 being bottomed at 3,200′. Work on this lode was sufficiently extended to fully demonstrate the worthlessness of the Calumet conglomerate on Centennial lands. The present management did but little work on the Calumet lode and abandoned the conglomerate shafts in 1897. Attention was next paid to the Osceola amygdaloid, underlying the conglomerate. There were 2 shallow shafts on the Osceola lode, sunk at an angle of 38°, and these were deepened and developed, 1897–1900. These shafts furnished considerable rock to the mill, but work was stopped because better developments were secured on the Kearsarge lode, still farther west. The Osceola shafts are 7x12′ inside of timbers, and are 1,050′ and 1,150′ in depth, respectively.

The Kearsarge amygdaloid underlies the Centennial's mile square tract, but outcrops slightly east of the southeast corner, hence the purchase of 20 acres adjoining. Work was begun on this lode September, 1899, and has been pushed for more than three years. The peculiar situation regarding the outcrop of this lode caused the Centennial management to start two shafts, "A" and "B," only 90′ apart on surface, but diverging with depth. This plan of opening gives short drifts until the shafts enter the main Centennial tract, after which length is gained very rapidly with depth. At the close of 1902, "A" shaft was approximately 2,600′ and "B" shaft about 800′ in depth. Each is 7x18′ inside of timbering, with 3 compartments, and sunk at 39° with the horizon. The overburden is about 100′ and the shafts have exceptionally heavy timbering above the ledge of solid rock. These shafts can be sunk to a depth of 10,000′ each, on the Centennial lands. While both shafts show copper from the top of the lode down, there is a slow but steady improvement in values with depth. The lode is 15′ to 18′ wide and shows excellent values in the lower levels of "A," the deeper shaft, especially in the north drifts, with much rock of lesser value but fair milling grade in the levels above and in "B" shaft. At the close of 1902 the Centennial has underground openings aggregating nearly 2½ miles on the Kearsarge lode. It will be possible to drift for nearly a mile north and south from the present bottom of "A" shaft.

The location of both shafts in such close proximity permits the concentration of machinery and buildings at a single point. The shaft-rockhouse at "A" is 36x42′, with full rock-breaking outfit. The Mineral Range railroad runs to the shafts, permitting economical transportation of fuel and material. The boiler house, 54x58′, is well arranged for receiving fuel and disposing of ashes, and has four 125-h. p. Burt locomotive-firebox boilers. A stone building, 32x46′, houses a 35-drill air compressor, with Dean jet condenser in the basement. A frame pumphouse with iron roof, 16x46′, has a steam pump, hose, hose-carts, etc., for fire protection. A miner's changing house, of wood, 25x50′, has the usual conveniences of hot and cold water, lockers, etc. A Nordberg hoist was installed in 1902. This has 32x72″ cylinders, and is good for a depth of 6,000′. The engine house is of stone, 50x70′. The miscellaneous mine buildings include well-fitted machine, blacksmith and carpenter shops, standing in a row; warehouses, barns, office buildings, dwellings for employes, etc. There are four air compressors, of 10, 12, 15 and 35-drill capacity, respectively. The mechanical equipment of the mine is good, the arrangement of surface plant convenient, and the various structures are well built, spacious and commodious.

The old mill was closed in February, 1902, and is not likely to be used again. This has one stamp, 21 jigs and 2 slime tables, with a daily capacity of 225 to 250 tons, or about one-half that of a modern head. The Centennial company owns a fine millsite on Torch Lake, opposite the Calumet & Hecla stamp mills. The use of one or two stamps at the Arcadian mill probably can be secured, if desired.

The Centennial lands are in the great mining camp of Calumet and are available for building purposes. Two additions have been platted and the lots sold at good prices. Only surface rights are sold, mineral below the surface being reserved by the company.

**CENTENNIAL-EUREKA MINING CO.** **UTAH.**

At Eureka, Juab Co., Utah. C. G. Allen, general manager; R. A. Brown, superintendent. Primarily a gold and silver mine but is securing considerable copper latterly. Has steam and electric power and concentrator; employs about 200 men.

**CENTRAL MINING CO.** **MICHIGAN.**

Office: 11-13 William St., New York. Jos. E. Gay, president; John Stanton, secretary and treasurer; F. McM. Stanton, agent. Mine, in Keweenaw Co., Mich., was opened 1854, on a fissure vein, and closed down 1898, after paying $1,970,000 in dividends. Diamond drills have been used to explore the territory and a 16′ amygdaloid giving heavy copper in the cores was located late in 1900. A plant to re-work the tailings from the old mill is being installed under the superintendence of Todd C. Woodworth. Official sworn returns to the state of Michigan as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $ 100,000.00 |
| Entire amount invested in real estate | 2,282.35 |
| Amount of unsecured or floating debt | 23,153.14 |

**CENTRAL BLACK HILLS COPPER CO. SOUTH DAKOTA.**

About 15 miles northwest of Custer City, S. D. Capitalized at $1,000,000. Office, Cleveland, Ohio, but not found by postal authorities. Said to have a large body of low grade carbonate ore and to be installing a 100-ton leaching plant, late in 1902. Is claimed vein is 40′ wide and averages 3% copper.

**CENTRAL CHILE COPPER CO., LTD. CHILE.**

Offices: St. George's House, Eastcheap, London, E. C., Eng. Mine office: Panulcillo, Ovalle, Chile. Capital, nominal, £300,000; issued, £276,248; debentures, £23,752, at 4%. Company and its predecessors have worked the Panulcillo mines since 1894; these mines include the Panulcillo, opened 1894 and making about 1,400 tons yearly, and the San Gregorio, at Panucillo. Also owns the Inagotable, Cocinera and Condesa mines, at Huamalota Sotaqui, Ovalle. Smelter is at Panulcillo. Ore reserves estimated at 500,000 tons, running 4% to 7%. Company owns 50,000 shares of Carmen Copper Mines, Ltd., and paid dividends of 6d. per share, 1899 and 1900.

**CENTRE STAR MINE. BRITISH COLUMBIA.**

Located at Rossland, B. C. Produces a limited amount of copper as a by-product from silver-lead ores.

**CENTURY MINE. ONTARIO.**

Address: Care of Foster & Black, Sudbury, Ont. Location, Graham Twp., Algoma, Ont. Assays give 7% to 13% copper, and from a trace to $26 gold per ton.

**CERESIER MINE. FRANCE.**

Was the principal copper producer of France, when working, but has been idle for some years.

**CERRO COPPER CO., LTD. PERU.**

Offices: 19, Birchin Lane, London, E. C., Eng. W. H. Watts, chairman; H. J. Page, secretary. Registered, Oct. 27th, 1900. Organized to acquire mines in Peru. No returns secured.

**CERRO DE PASCO MINING CO. PERU.**

Address: care of Jas. B. Haggin, 203 Aldrich Court Bldg., New York. Peruvian general office: Lima, Peru. Mine office: Cerro de Pasco, Peru. Organized June 6, 1902, under laws of New Jersey, with capitalization $10,000,000. Control supposed to be owned by Jas. B. Haggin, H. McK. Twombley and others, of New York. Alfred W. McCune, general manager, Lima, Peru; A. E. Welby, superintendent of railroad, Oroya, Peru; Jas. MacFarlane, superintendent of mines, Cerro de Pasco, Peru; Frank Klepetko, consulting engineer; E. H. Repath, assistant consulting engineer.

Silver was discovered at Cerro de Pasco in 1630, and silver mining has been continuous since that time, though greatly lessened by the recent decline in the price of the metal. The silver production of the district to the close of the Nineteenth century is placed at 450,000,000 ounces, and it is estimated that 40,000,000 tons of silver and copper ore have been mined in this district since 1630, nearly all of which has been extracted by hand labor and carried on the backs of llamas 3 to 6 miles to primitive smelters, the silver bullion being transported by llamas to Lima until some thirty years ago, when the railroad was completed to Oroya. The Cerro de Pasco district is 210 miles from Callao, the nearest seaport. The preliminary work of the present company was carried on by the South American Development Co., which bought about four-fifths of the developed claims in the district at a price said to aggregate £530,000, payable in installments. The official Peruvian register for 1899 gives 546 registered mining claims in the Cerro de Pasco district, and, including abandoned properties, there are probably about 1,000 claims, each 30x60 varas in size. The present company is supposed to control 75% to 80% of all the claims in the district, and is still buying, though at advanced prices, and now controls approximately one square mile of rich ground.

The district is located 14,300′ above sea-level, rendering physical labor very fatiguing. The population of the town is variously estimated at 5,000 to 12,000. The surrounding country is bleak, and all food and other supplies must be brought in from a distance. From November till April there are heavy rains and deep snows.

Authorities disagree most atrociously as to the geology of the district. All that can be said with certainty is that in an area approximately one mile wide and between one and two miles in length, there is ore in nearly every claim, rendering the Cerro de Pasco one of the richest mineral deposits of the globe. The ores carry gold, silver, copper, cobalt and other metals The values are found in two zones, the upper carrying mainly silver, in quantities from a few ounces to thousands of ounces per ton, in decomposed quartz. Considerable gold is found in the upper zone, this running as high as 1 to 2 oz. per ton, occurring in rich but erratic chutes. The silver values usually extend to a depth of about 100′, followed by silver-copper ores and a little lower by copper-silver ores. All of the copper ore is more or less argentiferous, being estimated to average 15 to 35 oz. of silver per ton. Practically all of the copper ore is bismuthiferous, rendering it highly refractory in metallurgical treatment. In the past only the richest ore has been worked, the ores shipped ranging 25% to 40% in value. Claims advanced that the ore of the district will average 25% copper are entirely unwarranted, as the high-grade ore shipped was carefully hand-selected, owing to excessive transportation charges. However, it is unquestionable that the Cerro de Pasco is not only one of the world's largest copper deposits, but is also very high in the percentage of copper carried. Despite the working of mines for nearly three centuries, the development secured has been merely surface scratching. The water level is about 250′ below surface, and what will be found below that depth remains to be determined, though every indication favors the finding of sulphide ores of good grade and great permanence. The so-called mines of the district are more like gopher holes or rabbit warrens than real mines, none of the old openings being deeper than 200′, in any but a few cases. The present company is sinking nine 2-compartment shafts, which will be put down to good depths. There are three drainage tunnels in the district, of which the most ambitious is the Rumiallana, begun by Henry Meiggs in 1877, and discontinued when 1,000′ long because of his death. Meiggs held a concession from the Peruvian government for 25% of the gross ore values extracted by the mines drained through this tunnel. His concession is now held by another company, and there is a possibility of litigation between the present owners of the mine and the owners of the tunnel concession, if the latter complete the tunnel. The ore in sight in the district was estimated in 1899 at 5,000,000 to 6,000,000 tons.

The Central Railway of Peru, built at a cost of $43,000,000, 130 miles from Callao to Oroya, climbs 3 miles in this distance. The Cerro de Pasco company holds a concession from the government for a railroad from Oroya to Cerro de Pasco, and this road is now being constructed, with an average grade of 1.5% and maximum grade of 3%. The line will be about 80 miles in length, costing $2,000,000 or more, and requiring about two years to construct and equip. This road is an absolute necessity for the successful operation of the mines on a large scale, as it is manifestly impossible to pack heavy mining machinery on the backs of llamas or burros for 80 miles over one of the ruggedest mountain chains of the globe.

Mining costs were estimated in 1899 at $1.50 to $2 per ton, but can be reduced by proper equipment and transportation facilities. Wages are 25 to 50 cents per day for natives, and $2.50 to $4 per day for white labor. Peru is on a gold basis. The present freight rate on ores is £8 per ton from Cerro de Pasco to Oroya, £1 10s. Oroya to Callao by railroad, and £3 Callao to Swansea, by steamer, giving a total transportation charge of £12 10s. between the mines and smelters. The present company will, of course, arrange to do its own smelting, but at what point has not been ascertained.

This property is one of vast magnitude, and exceptional promise, but the difficulties, financial, geographical and metallurgical, in the way of the adequate development of the mines, are very great, and several years will be required before the company can become an important factor in the production of copper. The property is in the hands of people of financial ability equal to any possible requirements and Mr. Haggin and the executive staff of the company are men who have accomplished great things in American copper mining.

**CERRO DE PASCO TUNNEL & MINING CO. PERU.**

Office: 35 Wall St., New York. Organized under laws of Maine, with capitalization $12,000,000, half in 7% cumulative preference shares of $10 and half in $10 common shares. As near as can be learned company has an option for the purchase of the Rumiallana or Meiggs drainage tunnel in the Cerro de Pasco district, and holds 50 claims of about 250 acres 37 miles from Lomas, in the Acari district of Peru.

**CERRO MURIANO MINES. SPAIN.**

Owned by Cordoba Exploration Co., Ltd.

**SUCESION CERVERO. CHILE.**

At Cabildo La Ligua, Chile. Operates the Cabildo mine, opened in 1886, producing equivalently 800 tons refined copper yearly, shipped as matte. Also owns the following old mines at Nipa and Coligue: Montoya, opened 1855, developed by 900′ tunnel; Castillo, opened by 400′ shaft; Quisco, opened by 300′ shaft, and Cuevas, opened by 120′ shaft.

**CETINI MINE.** **ITALY.**

Near Pisa, in the Volterrano district of Italy. This is a new mine, with occurrence and nature of ore similar to the Montecatini, and is a small producer of copper.

**CHAMPION COPPER CO.** **MICHIGAN.**

Office: 27 State St., Boston, Mass. Mine office: Painesdale, Houghton, Co., Mich. Already a large producer and destined to become one of the world's greatest mines. Organized under Michigan laws, December, 1899, with capitalization $2,500,000 in 100,000 shares, par $25. Entire stock issue owned jointly by Copper Range Cons. Co. and St. Mary's Mineral Land Co. Wm. A. Paine, president; Frederic Stanwood, secretary and treasurer; W. A. Paine, S. L. Smith, C. H. Paine, A. G. Stanwood, J. Malcolm Forbes, Geo. P. Gardner and Richard Olney, directors. Dr. Lucius L. Hubbard, general manager; F. W. O'Neil, mining engineer; John Broan, mining captain; John Mackay, mill superintendent.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $ 875,000.00 |
| Amount paid in by conveyance of property to company | 1,025,000.00 |
| Entire amount invested in real estate | 1,025,250.00 |
| Amount of personal estate | 492,983.43 |
| Amount of unsecured or floating debt | 70,850.38 |
| Amount due the corporation | 16,827.60 |

Mineral lands consist of the south half of Section 30; west half, north half of northeast quarter and southeast quarter of northeast quarter of Section 31, Town 54 North, Range 34 West; southeast quarter of Section 25 and east half of Section 36, Town 54 North, Range 35 West, making a compact tract of 1,240 acres, practically all of which is on the mineral belt. Neighbors of the Champion are Copper Range and Trimountain on the north; lands of St. Mary's company and Hussey, Howe & Co. on the east; Hussey-Howe lands and the Globe property on the south, and the Copper Range tract on the west.

Development was begun in the spring of 1899, under direction of Dr. Hubbard, who resigned the position of state geologist to take charge of this property, and his work was crowned by immediate success. Three parallel amygdaloids were uncovered by trenching across the formation at right angles, and one of these, identified as the Baltic lode, showed phenomenal copper values. Ten test-pits were sunk at intervals on this lode and all were bottomed in the same rich rock. The two parallel amygdaloids show copper in sufficient quantity to render their exploration advisable at some future time. A fourth amygdaloid, about 15′ wide, was discovered east of the Baltic lode in 1901; this carries heavy copper to a promising extent, but is not being developed. In addition to the four cupriferous amygdaloids already found on the Champion lands, there is a fissure vein of arsenical ore, apparently algodonite, near "C" shaft. The width of this vein at surface is slight, and mineral contents variable, but on the second level the fissure is 2′ wide and well mineralized.

The Baltic lode dips at 70° at the Champion, but has about the same strike as at the Trimountain, rather than the exaggerated easterly trend noted at the Baltic mine. The lode runs 13′ to 45′ in width at various points where opened in the Champion, averaging about 25′, and carries more epidote than at the Trimountain and Baltic. The surface is very hilly, notwithstanding which the overburden is less than to the northward and southward. The stretches of lean ground in the mine, so far as opened, are unusually few. The lode carries heavy copper in profusion, mostly in barrel size, but running up to masses of 10 tons weight. The Champion has nearly 9,000′ on the strike of this lode, and can go down nearly three miles on its own lands, if such depth can be attained without roasting the miners. The mine had about five miles of underground openings at the close of 1902, or double the openings of one year before.

There are four shafts, numbered from north to south, with room for four more shafts. "B" shaft, the northernmost, is 1,835′ south of the Trimountain line, with collar 635′ above mean water datum of Lake Superior, and was 771′ deep Nov. 1, 1902. "C" shaft is 1,050′ south of "B," 616′ above the lake and 729′ deep. "D" shaft is 1,300′ next south, 621′ above the lake and 818′ deep. "E" shaft is 1,300′ next south, 3,900′ north of the boundary line with the Globe tract, and was 985′ deep Nov. 1, 1902. All four shafts are connected on the second and third levels, while "D" and "E" are connected on the fourth and fifth levels, and drifting is in progress for numerous other connections. The lode has so little poor ground that in all likelihood every level will be driven from end to end of the mine, giving the the longest levels ever opened in any Lake Superior property, if not in the world. The only poor showing made in the mine is at "E" shaft, where the ground is disturbed and carries little copper on the second and third levels, but becomes quite regular and well mineralized on and below the fourth level. At the close of 1902, "D" shaft is showing the best ground in the mine, and has some stopes that are phenomenal for width and richness. These probably carry as much copper per running foot as the best stopes of the Calumet & Hecla.

The shafts are supplied with combination shaft-rockhouses 40x50′, each fitted with steam hammer for mass and barrel copper, 3 crushers, engines and storage bins, the buildings and equipments being exactly similar at all four shafts. Each shaft has a hoist good for 1,500′ depth.

The new machine shop, smithy, boiler house and compressor building are of steel, and are nearing completion at the close of 1902. The shops will be supplied with the best possible equipment of tools, machinery and labor-saving devices. The boiler house will have 3 Geary boilers, and is to be doubled in size eventually. The principal mine buildings are located in the ravine across from the point where "F" shaft was started, but abandoned because of the treacherous overburden, about a quarter mile south of "E" shaft. The ravine has been dammed and impounds 12,000,000 gallons of water for the boilers and fire protection for mine buildings and townsite. The dam is built up from excavations to hardpan, and is 30′ from base to crest, with a cement core 5′ at bottom and 2′ at top, reinforced by rock. Near

"B" shaft there is a 40-drill Ingersoll-Sergeant cross-compound two-stage air compressor with vertical receiver intercooler, installed in 1901. Near the site of "F" shaft a new steel compressor house is being built. This will have a Nordberg compressor of 100-drill capacity, to be installed in 1903. This machine is designed on new lines and is expected to prove remarkably efficient. The electric plant, now at "B" shaft, will go into the new compressor building and will be enlarged. The installation of electric haulage underground is being given consideration. The Champion is peculiarly adapted to this form of traction, because of its regularity in underground openings and the wonderful length of its levels. Such a plant should be installed, by all means, at an early date. There is also a fine coal trestle at "F" shaft. This has railroad tracks on trestles, with a tunnel below each, coal falling through hatches into cars in the tunnels leading to the boiler house. The entire plant at "F" shaft is exceptionally well designed, advantage having been taken of the topography to lay out all improvements in a way to save unnecessary labor.

The townsite at the mine, owned by the company, is called Painesdale. Many noble maples were spared when the site was cleared and the town is unusually attractive for a mining location. There are about 100 dwellings, also a hotel, several business structures and a good schoolhouse. The Sarah Sargeant Paine memorial library is a handsome stone structure, now being erected at a cost of $30,000, by President Wm. A. Paine, as a memorial to his mother. More than one memorial building has been erected in New England from the profits of Lake Superior copper mines, but it remained for Mr. Paine to graciously blend the loving remembrance of a mother with a benefaction to the working people whose labor has added to his wealth.

The Painesdale branch of the Copper Range railroad has its terminus at the Champion and gives passenger and freight service, as well as transporting Champion rock from the mine to the mill.

The mill is at Freda, on the Lake Superior shore, about two miles west of the Atlantic mill at Redridge. Excavation was begun in the spring of 1901, and the mill should be in commission in January, 1903, the usual delays having been experienced in receiving machinery. Under each head is a 15′ concrete foundation. There are cement floors in the washrooms, these being cleanly and practically indestructible. The mill was built by the Wisconsin Bridge & Iron Co. and equipped by the Nordberg company. The steel mill building is 178x215′, with room for four heads, of which three will be set in place at the start. Sixteen Overstrom concentrators have been installed and 24 more will be added. The jigs are of the new Hodge type, with graduated adjustable speeds, having plungers to work simultaneously, or alternately in pairs.

The heating system of the mill was designed by Jesse Coogan, and utilizes hot water from the economizers, piped at 300° to 350° Fahrenheit to a steel-clad chamber, whence the heated air is drawn into ducts by a blower and distributed through the mills. The water is pumped back to the economizers and thence fed to the boilers. The steel boiler house has five 250-h. p.

Springfield boilers of Scotch type, with room for five more. There is a Green fuel economizer and the grates are fed by a Detroit automatic stoker. Forced draught is furnished by a Sturtevant blower, and ashes are washed into the lake through a launder by jets of water. All coal fed to the stokers is reduced to uniform size by a grinder. Exhaust steam passes through dry condensers, thence to a hot-well from which water is fed into the boilers at a high temperature.

The steel pumphouse is 40x60′, with truss roof and traveling crane, housing a 20,000,000-gallon triple-expansion Nordberg pump. Water for the mill and boilers comes from Lake Superior through a tunnel 1,020′ long, the shore end having a well with bottom 8′ lower than the lake level. This is the longest tunnel ever driven under Lake Superior, and is a credit to F. W. O'Neil, who designed it, and to Capt. W. Z. Karkeet, who drove it. There is a fire pump at the mill, and five hydrants in the townsite, which has about 15 dwellings. There are also carpenter, machine and blacksmith shops, warehouses, etc.

The Champion began production Jan. 10, 1902, with one leased stamp at the Atlantic mill. The first 6 weeks' run gave 48¼ lbs. mineral per ton, equal to 36 lbs. refined copper. A second leased head was started on Champion rock at the Baltic mill in August, 1902. In December, 1902, the mine was furnishing about 700 tons of rock daily, from development work alone. The magnificent stopes to be seen in every shaft render it certain that the Champion can feed four stamps with ease, and the capacity of the mill will have to be increased within a year or two. A safe estimate, because a conservative one, would be that the mine will return 30 to 35 lbs. of copper per ton, with comparatively little selection. Beginning early in 1903 the Champion should produce at the rate of 500 tons of mineral monthly, and increase this amount largely before the year is ended. It is a question of a little time only when the Champion will be crowding Tamarack and Quincy for second place among Lake Superior copper producers, and eventually it should turn out copper at a rate nearly or quite equal to the Tamarack and Quincy combined. This will take time, but the Champion has the copper, and it has a management that is aggressive, fearless and successful. The Champion is a bigger and better mine than is realized by any but the few most conversant with its characteristics, development and possibilities.

**CHAMPION GOLD & COPPER MINING CO.**

Office: California Blk., Tacoma, Wash. No returns secured.

**CHAMPLAIN MINING CO. IDAHO.**

Supposed to have claims in the vicinity of Doniphan, Blaine Co., Idaho.

**MINA LA CHAPARRITA. SPAIN.**

At Nerva, Huelva, Spain. A group of 11 old mine openings, area 106 hectares. A little copper is produced by cementation from the mine waters.

**CHARLOTTE & CONSTANCE MINES. NEW CALEDONIA.**

Near Bonde, New Caledonia. These properties show large outcrops and have been described by the French authorities as mountains of ore but it cannot be learned that any serious attempts at developments have ever been made.

**CHARTER OAK COPPER MINES, LTD. WYOMING.**

Office and mines: Saratoga, Carbon Co., Wyo. Idle. Organized 1898, under laws of England, with capitalization £40,000 shares £1 par. H. Seton Karr, president; S. Loten Willcox, treasurer; J. B. Hassett, local manager. Lands, 4 patented claims, area 84 acres, also 5 acre millsite, in Upper Platte district of Carbon Co., showing 2 fissure veins, average width 12′, carrying oxide and sulphide ores assaying 4.5% copper, $4 gold and 2 oz. silver per ton. Main shaft, 488′, with 750′ underground openings. Steam power equipment. Manager states that former development was misdirected and shaft was sunk at right angles to vein. Company hopes to resume development along saner lines at an early date.

**CHASE CREEK COPPER CO. ARIZONA.**

Mine office: Clifton, Graham Co., Ariz. Capitalization, $5,000,000. Clarence K. McCornick, Salt Lake City, president. Lands, 44 claims, many of which adjoin developed mines in the Clifton district, Property possesses great speculative value and company is understood to have strong financial backing.

**CHAVEZ MINE. NEW MEXICO.**

Near Riley, Socorro Co., N. M.; no returns secured.

**CHELAN COPPER CO. WASHINGTON.**

Owns the Texas Jack copper claim, in Upper Horseshoe Basin, Washington. Vein is 30′ between walls in places, with pay streak of about 20″, carrying copper and silver values.

**CHENIUS FALLS COPPER MINING CO. WASHINGTON.**

Incorporated July, 1902, with capitalization $1,000,000 by F. C. Robinson, et al, of Spokane, Wash. Has 2 claims, on the Chenius river, about 7 miles from Fairfax, Pierce Co., Wash.

**CHIAPAS MINING CO., LTD. MEXICO.**

Offices: 35, Queen Victoria St., London, E. C., Eng. Mine office: Chiapas, via Teapa, Tabasco, Mexico. Employs about 300 men. Capital, nominal, £252,500. C. G. Hall, chairman; G. A. V. Narraway, secretary; H. F. Collins, general manager. Lands, about 30 acres, carrying gold, silver and copper. Opened by 200′ shaft and 1,560′ tunnel. Water power; 30-stamp mill; 100-ton concentrator; 75-ton smelter. Ores treated in 1899 averaged 3% to 4% copper, with large gold and sliver values; concentrated ores gave 40% copper, 0.02% gold and 0.02% silver per ton.

**CHICAGO NICKEL CO. ONTARIO.**

Owns prospects in Drury Twp., Algoma district, near Worthington, Ont., showing copper-nickel-iron ores. No returns secured.

**CHICAGO-ALGOMA NICKEL CO. ONTARIO.**

A property near Sudbury, Algoma, Ontario, opened by shafts and carrying copper and nickel ores. Letters addressed to company at Sudbury returned unclaimed, October, 1902.

**CHICAGO & KOOTENAY MINING CO.** **BRITISH COLUMBIA.**

At Hall, Yale & Cariboo district, B. C. C. T. Sleeper, superintendent. Ores carry copper and gold; mine opened by shaft; steam power; 12 men employed.

**CHICAGO VENTURE MINING CO.** **WYOMING.**

Office and mine: Encampment, Carbon Co., Wyo. Employs small force. Organized 1901, under laws of Wyoming, with capitalization $1,000,000, shares $1 par, non-assessable. R. H. Young, president and general manager; R. Z. McCoy, secretary and treasurer. Lands, 6 claims, area 115 acres, said to have 2 contact veins; 2 tunnels, longest 120′. Will continue development work in 1903.

**CHICAGO & YELLOW METALS MINE.** **WASHINGTON.**

Has copper-gold prospects, about 20 claims, on the extension of the Norway-Sweden-Denmark belt, in the valley of the North Toutle river, Washington.

**J. K. CHILD & CO.** **BOLIVIA.**

Operators of native copper mines in the conglomerate strata at Coro Coro, La Paz, Bolivia. According to American consul at La Paz, are now producing at the rate of about 600 tons of barillas de cobre carrying 80% fine metal, yearly.

**SOCIEDAD CHILENA DE FUNDICIONES.** **CHILE.**

Operates the Tongoy mine, department of Ovalle, Chile, opened in 1860, and producing about 700 tons yearly, as bars; also the Guayacan mine, opened in 1856, making about 8,000 tons annually in bars and ingots.

**SOCIEDAD UNION MINERA CHILENA.** **CHILE.**

A Chilean company, operating the Condesa and Union mines, at Cobija, Tocapella, Antofagasta, Chile.

**CHILLAGOE COPPER PROPRIETARY, LTD.** **AUSTRALIA.**

Offices: 22, Austin Friars, London, E. C., Eng. Company moribund and to be dissolved.

**CHILLAGOE RAILWAY & MINES, LTD.** **AUSTRALIA.**

Offices: Finsbury House, London, E. C., Eng. J. S. Reid, chairman; F. Back, managing director; General Sir H. W. Norman, trustee for debenture holders; E. A. Weinberg, general manager; G. Smith, mine manager; E. Habben, secretary at London; C. L. Hewitt, secretary at Melbourne; R. D. Frew, agent at Brisbane; R. N. Kirk, agent at Sydney, N. S. W. Mine office: Chillagoe, Queensland. Capital, nominal, £1,000,000. Property is railway and mineral concessions granted by the Queensland government. Railroad is 102 miles, from Mareeba to Chillagoe, Queensland. Mineral concessions, 2,000 acres on 50-year lease from 1898, at annual rental of £2,000, without labor conditions, also 1,200 acres under ordinary mineral leases. Work has been performed on 17 leases. Work of initial management was not satisfactory. Smelter plant includes 6 furnaces; 8,129 tons ore treated in 1901 gave 367 tons copper, 15,721 oz. silver and 72 oz. gold. Mines and smelters closed down at end of 1901, pending rearrangement of plans and finances; supposed to be in operation at close of 1902.

**CHIPPEWA COPPER MINING CO. WISCONSIN.**

Office: 804 Winthrop Bldg., Boston, Mass. Mining property, near West Superior, Douglas Co., Wis. Company is in financial straits and property to be sold for debts of about $13,000, unless reorganization can be effected.

**CHITNA EXPLORATION CO. ALASKA.**

Office: probably Portland, Ore. Owns the Nickolai group of copper prospects on the headwaters of the Chitna river, Copper River district, Alaska, about 140 miles inland from Valdes. Has shallow shaft, showing native copper and sulphide ores. Property will be rendered accessible by the construction of the Alaska Central railroad.

**CHOIX CONSOLIDATED MINING CO. MEXICO.**

Mine office: Choix, Sinaloa, Mexico. Property shows oxidized ore specimens running above 80% copper, and sulphide ores giving 20% to 25% copper, considerable silver, and about $15 gold per ton.

**CHOTA NAGPUR MINES. INDIA.**

At Chota Nagpur, Bengal, India. Were worked in very ancient days. Ore occurs as chalcopyrite, disseminated in schistose rocks. A local company has recently done a little development work on the property.

**CHTASTIE MINE. BULGARIA.**

Held under lease from the principality by MM. Stojanoff, Varbanoff & Co., of Plevna, Bulgaria. Lands, 250 hectares, are at Belogradchik, Vidin, Bulgaria. Employs 20 men. Has 2 fissures veins, averaging 2½′ wide and 600′ long, carrying chalcopyrite assaying 18% copper, 2 dwts. gold, 8 oz. silver per ton. Has 3 shafts, deepest 260′ and 15 short tunnels, aggregate length 700′. About 5,000 tons of ore in sight. Property is 22 miles from Akchar, on the Danube. Management will deepen shaft 350′, extend tunnels 1,500′, install steam plant and begin production in 1903.

**CIENGUITO COPPER CO. MEXICO.**

Dr. J. M. Ford, Phœnix, Ariz., treasurer. Property is in the Sierra Madre Mountains, about 25 miles from Sahuaripa, Sonora, Mex. Country is wild and very slightly developed, and company has been interrupted in development by the rebellion of the Yaqui Indians. No direct returns secured from the property, but it is said to be of great promise, and people behind the company are men of good standing.

**CIRCUMSTANCE GOLD & COPPER MINING CO. ARIZONA.**

At Huron, Yavapai Co., Ariz. J. W. Nelson, superintendent. Was prospecting with small force of last accounts.

**CLAIRE COPPER CO. IDAHO.**

At Montpelier, Idaho. Chas Huff, superintendent. Company is planning erection of smelter.

**CLAIRMONT MINE. MONTANA.**

At Stevensville, Ravalli Co., Mont. Amos Buck & Co., owners. Was prospecting with small force, at last accounts.

**CLARA COPPER CO. UTAH.**

Location of company's property and office not learned.

**CLARA ST. DORA COPPER MINING CO.** **AUSTRALIA.**

Offices: 142, Palmerston Bldgs., London, E. C., Eng. No particulars obtained.

**CLARK MINE.** **MICHIGAN.**

Address: care of Edouard A. J. Estivant, owner, Paris, France. Located south of Copper Harbor, Keweenaw Co., Mich. Area, about 1,900 acres. Opened 1858; made 93 tons, 1,915 pounds copper. Idle for many years.

**CLAYTON MINING & SMELTING CO.** **IDAHO.**

Near Clayton, Custer Co., Idaho. Laurence Green, superintendent. Has silver-lead-copper ores, opened by tunnels and equipped with water and steam power. Has a 50-ton smelter and employs about 100 men.

**CLEAR CREEK MINING & REDUCTION CO.** **COLORADO.**

At Russell Gulch, Gilpin Co., Colo. F. R. Carpenter, manager. Has gold-silver-copper ores; steam and electric power; employs about 50 men. Company has a pyritic smelter, recently enlarged, at Golden, Colo.

**CLEOPATRA COPPER CO.** **ARIZONA.**

Office and mine: Jerome, Yavapai Co., Ariz. Organized 1902, under laws of Arizona, with capitalization $4,000,000, shares $1 par, non-assessable, all paid in by transfer of property. G. W. Hull, president and general manager; H. E. Wilcox, secretary. Mining lands, 13 claims, 11 patented, area about 180 acres, in the Verde district of Yavapai Co. Claims show 8 fissure and gash veins, of which several are being developed, these running 1′ to 5′ in width and assaying 1% to 60% copper, 1 to 500 oz. gold and 1 to 500 oz. silver per ton. Ores are oxides, carbonates and sulphides. Has several shafts, deepest 75′, and 2 tunnels, of 300′ and 1,250′. Steam power and air compressor. Company will continue driving tunnels and opening drifts in 1903.

**CLEVELAND-ARIZONA COPPER CO.** **ARIZONA.**

Supposed to have claims near Ajo Basin, Arizona; no particulars secured.

**CLIFF MINE.** **MICHIGAN.**

Located in Keweenaw county, a few miles north of Calumet, Mich. Was the first dividend-payer among Lake Superior mines, and a large producer in early days. Opened on a fissure vein, supposed to be worked out; idle since 1878.

**CLIFTON CONSOLIDATED COPPER MINES OF ARIZONA, LTD.** **ARIZONA.**

Offices: 47, Old Broad St., London, E. C., Eng., and 40 Wall St., New York. Mine office: Clifton, Graham Co., Ariz. Employs 60 men. Capital, nominal, £500,000, shares £1 par; also has local company with capitalization $500,000, shares $25 par. J. H. Mace, chairman; R. Larchin, secretary; J. H. Mace, Maurice Fontaine, Comte Albert de Sories, F. L. Drummel and Jules Fribourg, directors of English company; L. A. Dunham, president of local company and general manager of property. Lands, 60 claims, in process of patenting, area about 1,000 acres, in the Greenlee district of Graham Co., showing a number of fissure veins; ores, principally sulphide with some oxides and carbonates, all carrying a little gold and silver.

Property adjoins the Arizona and Detroit mines. Has 7 shafts, of 70′, 75′, 100′, 105′, 110′, 220′, and 315′; also a number of tunnels, of which the longest are 220′, 450′, 700′, 800′, 1,000′ and 1,700′. Equipped with steam, gasoline and electric power. Has electric and diamond drills. For 1903 will push developments, including driving of 7,700′ tunnel for drainage and development, which, when completed, will be equipped with double track and electric locomotives. Company contemplates building a smelter in 1903. Holdings of company are valuable and a large amount of ore of good grade has been developed.

**CLIFTON COPPER CO. NEW MEXICO.**

Office: Deming, N. M. Mine office: Santa Rita, Grant Co., N. M. Organized 1900, with capitalization $500,000, shares $5 par. J. L. Burnside, president; F. F. Rogers, secretary; M. Z. Elliott, superintendent. Lands, in Central district of Grant Co. Has 5 shafts, deepest 235′, showing oxide, carbonate and sulphide ores and native copper. Company claims ore body is 40′ to 50′ wide and half-mile long. Has steam hoists, 100-ton concentrator with 2 Huntington mills, 2 Wilfley tables and 2 Standard concentrators. Property idle at last accounts.

**CLIFTON COPPER MINING CO.**

Promoted, 1898, by Julius Leszynsky, of New York. Financial operations not of a sort to appeal to conservative investors. Present address of company not found; location of mineral lands, if any, uncertain.

**CLIFTON COPPER BELT MINING CO. UTAH.**

Office: Salt Lake City, Utah. Frank L. Wilson, general manager. Has 8 claims in the Clifton district of Utah, showing 2 veins giving good assay values in gold, silver and lead.

**CLIFTON TINTO COPPER MINES, LTD. ARIZONA.**

Offices: 20–21, Lawrence Lane, London, E. C., Eng. Company dormant.

**CLIMAX MINING CO. WASHINGTON.**

Near Baring, King Co., Wash. Frank P. Smith, superintendent. Has 8 claims with 200′ tunnel and surface trenchings, showing argentiferous and auriferous bornite and chalcopyrite, of good assay values.

**COAHUILA MINING & SMELTING CO. MEXICO.**

Office: Apartado 72, Monterey, Mex. Mine office: Viesca, Coahuila, Mex. G. F. Meehan, president; Burt H. Whiteley, vice-president; R. E. L. Meehan, secretary and general manager; F. W. Draper, superintendent. Operates the Santa Maria, Sultana and other mines, producing copper, gold, silver and lead. Deepest shaft 700′; tunnel 1,000′. Has steam and electric power and 250-ton smelter. Employs about 500 men. Is conducted as a close corporation, but is an extremely profitable property and returns large dividends.

**COAST LINE COPPER CO. MEXICO.**

Property at La Calera, Altar district, Sonora, Mexico. John Henderson, general manager. Organized 1902, to take over holdings of the Porvenir de Sonora company.

**COBAR CHESNEY COPPER & GOLD MINING CO. AUSTRALIA.**

At Cobar, Robinson Co., N. S. W. Area 200 acres. Opened originally as a gold mine, there being no copper in the outcrop. Carbonate stains occurred at depth of 150′ and chalcopyrite coated with melaconite came in at 250′. Main shaft now about 600′. Ore carries 3% to 8% copper. with about 3 dwts. gold per ton. Has a 35′ ore body, 800′ length of which averages 3%. Ore smelted by the Cobar Co. Production for 1901 was 150 tons fine copper.

**EL COBRE MINES.** **CUBA.**

Office: 71 Broadway, New York. Mine office: El Cobre, Santiago de Cuba. Employs 200 men. Organized 1902, under laws of West Virginia, with capitalization $3,500,000, divided into $1,500,000 preferred and $2,000,000 common stock, shares $100 par, non-assessable. Chas. F. Rand, president and treasurer; Wm. Astor Chanler, vice-president; Wm. C. Tegethoff, secretary. Directors are preceding officers, Colgate Hoyt, Jas. C. Colgate, Wm. Henry Yale, L. H. Severance and E. J. Barney. Wm. C. Butler, general manager; T. E. Hurley, superintendent; Jennings S. Cox, Jr., consulting engineer. Lands, all patented, about 800 acres, with 200 acres other lands, including mill and smelter sites, in the municipal district of El Cobre, province of Santiago de Cuba. El Cobre railroad, owned by this company, runs from the city of Santiago to the mines. This property is easily the most important copper mine of Cuba, and was operated extensively from 1834 until the plant was destroyed during the rebellion of 1868, since which time it has been idle, until 1902. Production averaged a value of $1,000,000 yearly for the last 34 years of operation. Present owners control all of the developed mines in the district, also the railway, and the property is without question a very valuable one.

**COBRE GRANDE COPPER CO.** **MEXICO.**

Absorbed by the Greene Consolidated Copper company.

**LA COBRIZA MINE.** **MEXICO.**

At Matahuela, San Luis Potosi, Mex. Zepuno Zalasar, superintendent. Is operating a copper property, opened by tunnel, with force of nearly 100 men.

**COMPANIA COBRIZA.** **MEXICO.**

Letter sent to Tepezala, Aguascalientes, Mexico, returned unclaimed.

**COCHISE COPPER MINING CO.** **ARIZONA.**

Office and mine: Bisbee, Cochise Co., Ariz. Capitalization, $5,000,000, shares $1 par, non-assessable. L. C. Shattuck, president; S. K. Williams, secretary; Jos. Muheim, superintendent. Property lies north of and adjoining the Copper Queen and had a 300′ shaft in porphyry, at last accounts. No returns secured.

**COCHISE MINING & MILLING CO.** **ARIZONA.**

Office: Colorado Springs, Colo. J. M. Hawkins, president; H. M. Mason, secretary and treasurer. Organized under laws of Arizona, with capitalization $1,500,000, shares $1 par, non-assessable. Has copper claims in Cochise and Pinal counties, Arizona.

**COCONINO COPPER CO.** **ARIZONA.**

Office: 420 Merchants Loan & Trust Bldg., Chicago, Ill. Mine office:

Ryan, Coconino Co., Ariz. Employs 30 men. Organized 1901, under laws of New Jersey, with capitalization $6,000,000, shares $10 par. Donald Grant, president; T. F. Noonan, vice-president; L. P. Boyle, secretary; W. S. McCornick, treasurer. Directors are preceding officers, P. L. Kimberly, H. L. Ryan, and Moise Dreyfus. E. P. Jennings, general manager. Lands, 33 claims, area 660 acres, also 80 acres other lands, showing blanket veins carrying carbonate ores estimated to average 10% copper. Veins are stripped and worked open-cast. Estimated amount of ore in sight, 500,000 tons; blocked for stoping, 100,000 tons. Smelter at Ryan, 7 miles from mine, receiving ore by wagons. Company installed a 100-ton leaching plant using the new Neill process, late in 1902, and superintendent states that plant and process are an absolute success. The product is turned out as black copper. Company estimates output for 1903 at 2,000,000 lbs. refined copper.

The Neill leaching process, patented, is based on the solvent action of sulphurous acid upon copper oxides, carbonates and silicates, in the presence of water and an excess of the acid. The copper in the oxidized ores goes into solution as a sulphite, which, though insoluble in water, is soluble in an excess of sulphurous acid solution. When the excess of sulphurous acid is driven out by heat the cuprous sulphite is precipitated as cupro-cupric sulphite, a finely crystalline dark red salt, carrying 49.1% copper. The precipitate is smelted to blister copper, practically without fluxing. The sulphurous acid is made from roast-gases, and will dissolve more copper than sulphuric acid, while, being weaker, it does not dissolve other metals which foul the solution and absorb sulphur.

The process, as applied to the oxidized ores of the Coconino, is briefly, as follows: Ore is reduced by crushers and rolls to pass through a 20-mesh screen. The crushed ore is charged into a covered wooden tank containing wash-water carrying a little sulphurous acid, 2 tons of this watery solution being used to 1 ton of ore. The washed sulphurous acid gas is forced by an air compressor through the charge in the leaching tank, entering near the bottom. The process can be completed in one tank, but tanks in series are preferable. The pulp from the last leaching tank is drawn into another tank and forced into a filter press under air pressure. The cuprous solution from the filter press is conveyed by pipes to steam tanks, and the pulp remaining in the press is rewashed. The cuprous solution is heated by exhaust steam to boiling point, thus expelling the free sulphurous acid. Part of the copper is precipitated by gravity under heat, the balance of the solution being drawn off into other tanks and the copper precipitated therefrom by scrap iron or lime. The process is adapted to low-grade oxidized ores carrying neither gold nor silver values. It is also applicable to sulphide ores, roasted to drive off sulphur and oxidized in the process. If gold and silver values are carried in the ore, these can be secured by chlorination after leaching.

The Neill process has several highly promising features, and its practical application will be watched with great interest. The solvent is the cheapest known and in many cases can be secured practically without cost. The method of precipitation also gives very cheap costs.

**COLDWATER COPPER MINING CO. WYOMING.**

Office: Encampment, Carbon Co., Wyo. E. S. Drury, superintendent. Has claims near the Mt. Zirkel Co. Was developing at last accounts.

**SOCIEDAD COLECTIVA. CHILE.**

Has begun operations at the Tiltil mine, department of Santiago, Chile.

**COLONIAL COPPER CO. NOVA SCOTIA.**

Office: 32 Broadway, New York. Mine office: Advocate, Cumberland Co., N. S. Mine employs 225 men. Organized January 19, 1899, under laws of West Virginia, with capitalization $5,000,000, shares $1 par, non-assessable. J. A. Hanway, president and general manager; Jas. A. Young, vice-president; H. D. Hanway, secretary; A Munger, treasurer; preceding officers, A. W. Godding, W. J. Sneeringer, Chas. McNerly, Elisha Fenn, F. W. Hanright and J. J. Satterthwait, directors; S. M. Archibald, superintendent. Property, about 2,000 acres, showing 6 contact veins, of which 3 are being developed, these having average width of 25′ and carrying about 2½% native copper. Has 2 vertical and one incline shaft, latter 500′. Machinery outfit includes 3 Rand air compressors, 3 large and 6 small hoists, drills, blowers, etc. Has concentrating mill of 400 tons daily capacity, fitted with Blake crushers, rolls, jigs, tables, screens, etc., connected with mine, 1½ miles distant, by 36″ gauge railroad. Nearest railway, 30 miles distant, but property is located on the shore of the Bay of Fundy and all machinery and supplies are received by water. Company also owns the New Annan mine, carrying sulphide ore in lenses, and the Chandos mine, in Peterboro Co., Ontario, now idle, latter showing a 4′ vein assaying 8% copper.

**COLONIAL COPPER CORPORATION, LTD. AUSTRALIA.**

Offices: Salisbury House, London, E. C., Eng. Mines near Lithgow, Robinson Co., N.S.W. G. Hardie, chairman; C. P. Oswald, secretary; J. Wills, mine manager. Registered, March 29, 1899. Capital, nominal, £125,000; issued, £102,507. Lands, 245 acres. No work being done at present; property to let on tribute.

**LA COLORADO MINE. MEXICO.**

Located at San Xavier, Sonora, Mexico. Don Carlos Yanes, owner; Gabriel Robinson, superintendent. Is opened by a tunnel; employs about 20 men.

**COLORADO COPPER CO.**

Address: care of Wm. F. Wernse & Co., 421 Olive St., St. Louis, Mo. Company said to have lost its ground and stock probably worthess.

**COLORADO MINING & DEVELOPMENT CO. MONTANA.**

Office: 19 East Broadway, Butte, Mont. Capitalization, $600,000, shares $1 par, non-assessable. Has 2 claims, the Hidden Treasure and Copper Queen, at Corbin, Jefferson Co. Mont. Former has 150′ shaft showing high assay values in copper, gold and silver.

**COLORADO MINING & SMELTING CO. MONTANA.**

Office and mines: Butte, Silver Bow Co., Mont. R. F. Pearce, general manager; W. F. Wood, superintendent. Stock owned by the Amalgamated Copper Co. Operates the Gagnon mine, employing about 300 men. Main shaft, 2,000′ deep, sunk at an incline of 74°. Steam and electric power. Ore carries considerable silver and zinc blende. Has a smelter at Butte and treats custom ores as well as its own output.

**COLORADO & CONNECTICUT GOLD MINING CO. COLORADO.**

Office: 35 Wall St., New York. Organized 1902, under laws of South Dakota, with capitalization $400,000, shares $5 par, non-assessable. Wm. Garlick, president; John A. Thompson, vice-president; A. S. Garlick secretary; B. F. Barnes, treasurer. Lands are 3 claims, area 21 acres, in the Galena district of Hinsdale Co., Colo. Company is prospecting 3 fissure veins with average width 2′, assaying 9% to 19% copper, with good silver values. Ores, chalcopyrite and tetrahedrite, with some silver glance. Shaft, 50′, tunnel, 800′. Company will drive another tunnel in 1903.

**COLORADO RIVER GOLD & COPPER CO.**

Office: 321 W. Second St., Los Angeles, Cal. Company advertises that it "has 200 acres of phenomenally rich ground and will pay dividends as soon as smelter is on the ground," which is manifestly improbable. Furnished no returns in response to repeated requests.

**COLOSSAL GOLD & COPPER CO. UTAH.**

Organized 1902, with capitalization $600,000, by F. F. Brown, Wallace W. Wait, et al, at Salt Lake City, Utah, to take over the C. M. C. group of claims, in Beaver Co., Utah.

**COLUMBIA COPPER CO. ARIZONA.**

Offices: 919 Chestnut St., St. Louis, Mo. Zach W. Tinker, president; A. L. Steinmeyer, secretary. Has mining property near Globe, Gila Co., Arizona; no returns secured.

**COLUMBIA COPPER MINING CO. ARIZONA.**

Supposed to have claims near Jerome, Yavapai Co., Ariz. No particulars secured regarding the property.

**COLUMBIA COPPER MINING CO. UTAH.**

Office: McCornick Bldg., Salt Lake City, Utah. Employs 20 men. Organized under laws of Utah, with capitalization $75,000, shares 25 cents par. W. S. McCornick, president; J. A. Cunningham, vice-president; F. B. Cook, secretary and manager; Geo. W. E. Dorsey, treasurer. Directors are preceding officers and A. Hanauer. C. H. Cook, superintendent; Wm. Earle, mill superintendent; W. H. Horne, mining engineer. Lands, 14 patented claims, area 120 acres, in the West Mountain district of Salt Lake Co. Property developed by a number of shallow shafts and 2 tunnels of 62′ and 1,150′ with about 3,500′ of underground openings. Estimated amount of ore in sight, 1,000,000 tons. Has 20-ton concentrator. Production for 1902 was 318,885 pounds fine copper. Ore is chalcopyrite and width of ore body estimated at 100′ to 500′.

**COLUMBIA RIVER GOLD MINING CO. WASHINGTON.**

At Kettle Falls, Stevens Co., Wash. J. M. Fish, superintendent. Was developing gold-copper ores by tunnel, with steam power, at last accounts.

**COLUMBUS CONSOLIDATED MINING CO. UTAH.**

Mine office: Alta City, Salt Lake Co., Utah. Employs 18 men. Organized 1902, under laws of Utah, with capitalization $150,000, shares 50 cents par. Tony Jacobson, president and general manager; Arthur E. Snow, secretary and treasurer. Directors are preceding officers, L. A. Jeffs and A. O. Jacobson. Lands, 14 claims, 4 patented, area 145 acres, in the Little Cottonwood district of Salt Lake Co., showing 9 fissure and contact veins, of which 6 are said to average 12′ width, with estimated average values of 2.5% copper, 18% lead, 15% zinc, $1 gold and 14 oz. silver per ton. Has 4 shallow shafts and 3 tunnels, longest 900′, with 25,000 tons of ore blocked out for stoping. Steam power; compressor and air drills. Company intends to sink a new shaft to develop 6 new ore bodies, install hoist and water power plant, and erect 100-ton concentrator, in 1903.

**COLUSA-PARROT MINING & SMELTING CO. MONTANA.**

Office: 10 West Broadway, Butte, Mont. Employs about 500 men. W. A. Clark, president; A. H. Wethey, secretary; Chas. W. Clark, general manager; Thos. Bryant, superintendent. Capitalization, $1,000,000. Company managed as a close corporation. Ore is low-grade, but occurs in large bodies. Company operates the Original, Stewart and Colusa-Parrot mines. Latter has a two-compartment shaft, about 1,400′ deep and underground connection with the Parrot and Never Sweat mines. The Original mine has one shaft, about 1,300′. The Stewart mine has a 2-compartment shaft of 1,000′. Company also has smelter, which was rebuilt after fire of August, 1902.

**COMANCHE MINING & SMELTING CO. NEW MEXICO.**

Organized 1902, under laws of New Mexico. S. S. Curry, Ironwood, Mich., president; S. J. Laughren, Escanaba, Mich., secretary. Property is the Comanche group of partly developed copper claims, near Silver City Grant Co., N. M. Company understood to contemplate erection of 200-ton leaching plant at the mines, and 200-ton smelter at Lordsburg, N. M. No returns secured.

**COMILIA COPPER CO.**

Office: 802 Fullerton Bldg., St. Louis, Mo. Location of property unknown. No returns secured.

**COMMERCE GOLD & SILVER MINING CO. ARIZONA.**

Letter addressed to company at Duncan, Graham Co., Arizona, returned unclaimed, October, 1902.

**COMMODORE COPPER MINING CO. WYOMING.**

Office: probably at St. Paul, Minn. Mine office: Encampment, Carbon Co., Wyo. F. F. Mansfield, president; Theodore Streissguth, secretary; T. R. Countryman, vice-president and manager.

**COMMODORE MINES, LTD. BRITISH COLUMBIA.**

Capitalization, $750,000. Jas. R. Webster, president; W. H. Pegram, secretary. Advertises head office at Vancouver, B. C., but letter to company at that address returned uncalled for.

**LAS CONCAVAS. COSTA RICA.**

An old copper property in Costa Rica, opened in the Eighteenth century or earlier; now idle.

**COMPANIA MINERA CONCEPCION DEL ORO. MEXICO.**

Mine office: Concepcion Del Oro, Zacatecas, Mexico. Property active. Organized 1902, with capitalization $30,000, shares $30 par. Santiago Chamberlain, president; J. L. Kowalski, secretary and general manager; Santiago Chamberlain, Jr., superintendent; Juan Sanchez, mining captain. Lands, 32 patented claims, area 32 hectares, in Mazapil district of Zacatecas. Vein averages 4′ in width, carrying 30% copper, with gold and silver values in oxide ores. Shaft, 33 metres. Ore is shipped 336 miles to smelters at San Luis Potosi. Nearest railroad, Coahuila & Zacatecas, 8 miles distant. For 1903 will sink shaft 80 metres and install 24-h. p. gasoline engine.

**CONDON MINE. ARIZONA.**

At Oracle, Pinal Co., Ariz. T. C. Condon, owner; Geo. E. Metz, superintendent. Worked about 25 men at last accounts.

**CONEJO-COLORADO MINING CO. MEXICO.**

At Oaxaca, Mexico. Morris Clark, superintendent. Produces gold, silver and copper; opened by shafts and tunnels; equipped with steam power, two Huntington mills, 5 stamps and a 30-ton cyanide plant.

**CONGOR GOLD & COPPER MINING CO.**

Office: 506 Auerbach Bldg., Salt Lake City, Utah. Company gives no answer to inquiries.

**CONGRESS MINE. COLORADO.**

At Red Mountain, Ouray Co., Colo. Geo. H. Foltz, owner. Produces a little copper as a by-product from gold and silver ores. Opened by shafts and equipped with steam power. Employs about 20 men.

**CONGRESS GOLD & COPPER MINING CO. WASHINGTON.**

Office: Spokane, Wash. Jos. Roslow, president; J. Goodrich, secretary. Lands, about 80 acres, in the Keller district of Ferry Co., Wash. Opened by shafts and tunnels on 2 veins giving large assay values in gold, silver, copper and nickel. Was working small force at last accounts.

**CONQUEST CONSOLIDATED MINING CO. WASHINGTON.**

Office: 542, The Rookery, Spokane, Wash. John H. Shaw, president; J. W. Hays, secretary. Succeeded Conquest Gold & Copper Mining & Milling Co. Has about 250 acres of land.

**CONSERVATIVE MINING CO. WASHINGTON.**

Frank M. Evans, president; Hugh Kennedy, Silverton, Snohomish Co., Wash., secretary and manager. Property idle at last accounts.

**CONSOLIDATED AFRICAN COPPER TRUST. RHODESIA.**

Offices: in London, Eng. Organized early in 1902, with capital, nominal, £600,000, to take over and develop copper properties near the Zambesi river in Rhodesia, South Africa. Company said to be backed by very strong financial interests.

**CONSOLIDATED COPPER CO., LTD. CORSICA.**

Offices: Dashwood House, London, E. C., Eng. Registered, June 10, 1899. Capital, nominal, £100,000. S. Barry, chairman; C. Cook, secretary. Owns the Lancone copper mine, near Bastia, Corsica, which is idle at present.

**CONSOLIDATED COPPER CO. OF PARRY SOUND. ONTARIO.**

Office: Duluth, Minn. Mining lands, in Parry Sound district, Ontario. Company bought out the Hattie Belle Gold, Copper & Nickel Company. No returns secured.

**CONSOLIDATED COPPER CO. OF VIRGINIA.**

Temporary office: 317 Broadway, New York. Organized, October 1902, with capitalization $100,000,000. Franklin Bien, president and general counsel; Edw. P. Coyne, vice-president; Dr. Jos. E. Bissell, treasurer; Nathan E. Clark, secretary. Location of company's properties unknown, and no response secured to repeated requests for information.

**CONSOLIDATED COPPER MINING, MILLING & SMELTING CO. COLORADO.**

Office: 45 Bank Blk., Denver, Colo. Mine office: Eldora, Boulder Co., Colo. Employs 20 men. Organized 1900, under laws of Colorado, with capitalization $2,000,000, shares $1 par. J. B. Johnson, president and general manager; C. M. Hunt, vice-president; E. W. Kelly, secretary; W. W. W. Jones, treasurer. Directors are preceding officers, Gov. W. A. Poynter, A. M. Haggard, C. M. Smith, and L. F. Johnson. K. W. Hunt, superintendent. Lands, 11 claims, area 150 acres, showing 4 fissure veins carrying chalcopyrite, bornite and chalcocite, in an ore body 200′ wide, with pay-streak of 3′ to 20′ in width. Latter apparently averages 15% copper, 25% lead, $28 gold and 9 oz. silver per ton. Shafts are 40′, 65′ and 360′; also tunnel 400′ long Dec. 1, 1902, and progressing 5′ daily. Steam plant and air compressor. Company will push tunnel during 1903.

**CONSOLIDATED GOLD & COPPER CO. ARIZONA.**

Office: 66 Broadway, New York. Mine office: Clifton, Graham Co., Ariz. Capitalization, $1,000,000, shares $1 par. John I. Hutchinson, president; Floyd B. Wilson, vice-president; Fred K. Jones, secretary; E. M. Parker, treasurer. Lands, sundry claims near the mines of the Arizona Copper Co., in Graham Co., partly developed by tunnels and shafts, also lands in Yavapai Co. This is a dividend paying property, having paid one dividend amounting to the gross sum of $490.71. Not learned whether dividend was paid in currency or postage stamps.

**CONSOLIDATED GOLD & COPPER MINING & MILLING CO. WYOMING.**

Address: care of G. P. McGregor, St. Paul, Minn. Lands, near Encampment, Carbon Co., Wyo. Was developing with small force at last accounts.

**CONSOLIDATED KING DEVELOPMENT & COLUMBIA COPPER MINING CO. ARIZONA.**

Office and mines: Jerome, Yavapai Co., Ariz. Capitalization, $6,000,000, shares $1 par, non-assessable. Geo. W. Hull, president, treasurer and general manager; H. E. Wilcox, secretary. Lands, 34 claims, all patented but 3, area 400 acres, in Verde district of Yavapai Co. Has several ore bodies, showing oxide, carbonate and sulphide ores, with good assay values in copper, gold and silver. Several shafts, deepest 400′, also several tunnels, longest 1,200′. Gasoline and steam power. Will continue tunnels and development work in 1903.

**CONSOLIDATED MINING & SMELTING CO. NEW MEXICO.**

At Cerillos, Santa Fe Co., N. M. R. B. Thomas, manager; J. L. Wells, superintendent. Ores carry gold, silver, copper, lead and zinc. Company works Tom Paine, Albany and other mines, extensively developed, well equipped with gasoline and electric power and employing several hundred men. Has a 120-ton smelter and secures a little copper as a by-product.

**COMPANIA MINERA LA CONSTANCIA. MEXICO.**

Office: Saltillo, Mexico. Mines, near Sierra Mojada, Coahuila, Mex. Daniel Sada, manager. Operates the Juarez, Providencia, General Escobedo and other properties, producing silver, lead and copper. Deepest shaft 550′; also 2,000′ tunnel. Has steam equipment and employs several hundred men.

**CONSTANTINE COPPER MINING CO. WYOMING.**

Office: Winona, Minn. W. H. Elmer, president; J. H. Tousley, secretary; P. J. Winters, general manager. Property is in the Encampment district of Carbon Co., Wyo.

**CONSTELLATION MINE. ARIZONA.**

At Briggs, Yavapai Co., Ariz. Wm. F. Roberts, owner and manager. Has gold-copper ores, opened by shaft and tunnel.

**CONSTELLATION MINE. CALIFORNIA.**

At Campo Seco, Calaveras Co., Cal. E. J. Berger, superintendent. Was prospecting with small force at last accounts.

**CONTACT GROUP. ARIZONA.**

Seven claims, 15 miles from Globe, Gila Co., Ariz. Owned by A. A. Patterson.

**CONTENTION MINING CO. COLORADO.**

At Silverton, San Juan Co., Colo. G. E. Collins, manager. Has gold-silver-copper ores, developed by tunnels. Mine equipped with water and steam power; employs about 50 men.

**CONTINENTAL COPPER CO.**

Office: Colorado Springs, Colorado. No returns secured.

**CONTINENTAL COPPER MINING CO. WYOMING.**

Mine office: Battle, Carbon Co., Wyo. J. T. Brown, superintendent. Was working small force at last accounts.

**CONTINENTAL MINING CO. WYOMING.**

At Encampment, Carbon Co., Wyo. M. T. Whelan, superintendent. No returns secured.

**COONEY MINE. NEW MEXICO.**

At Cooney, Socorro Co., N. M. Has been a small producer of copper for some years; no returns secured.

**COONEY HILL GOLD & COPPER MINING & MILLING CO. WYOMING.**

Office: Cheyenne, Wyo. John Brown, secretary. Property supposed to be in the Encampment district of Carbon Co., Wyo. No returns secured.

**CO-OPERATIVE MINING CO. WASHINGTON.**

At Berlin, King Co., Wash. J. Kling, superintendent. Has gold-silver-copper ores; water power; worked 20 men at last accounts.

**CO-OPERATIVE MINING & MILLING CO.** **WYOMING.**

Near Encampment, Carbon Co., Wyo. S. E. Phelps, secretary. Was developing with small force at last accounts.

**COPAQUIRE COPPER SULPHATE CO., LTD.** **CHILE.**

Offices: 2 Basinghall Ave., London, E. C., Eng. Mines at Copaquire, Tarapaca, Chile. Registered, May 14, 1900. Capital, nominal, £300,000. Organized to acquire deposits of natural sulphate of copper and is engaged in the erection of a plant intended to treat a minimum of 1,000 tons daily.

**EL COPETE COPPER MINES.** **MEXICO.**

Located at El Copete, Ures district, Sonora, Mexico. An old property, worked by the Spaniards for gold and silver, and more recently as a copper mine, carrying good values in gold and silver as by-products.

**COPETE & MELEZER MINING CO.** **MEXICO.**

Near Ures, Sonora, Mexico. Erected a 250-ton smelter in 1901 and a large concentrator in 1902; no returns secured.

**COPIAPO MINING CO., LTD.** **CHILE.**

Offices: 16, Leadenhall St., London, E. C., Eng. Properties include the Dulcinea, San Francisco, Carmen Alto, Checo and Republicana mines, in the Copiapo district of Chile. A. Holland, chairman; W. S. Bartlett, secretary; W. T. Holberton, mine manager. Company registered April 23, 1861. Capital, nominal, £250,000. Is a dividend payer and produces 3,000,000 to 4,000,000 lbs. refined copper yearly.

**COPPER AGE MINING & SMELTING CO.** **WYOMING.**

Address: care of C. E. Miller, Jr., St. Paul, Minn. Lands, 12 claims, 2 miles north of Battle, Carbon Co., Wyo. Shaft, 100′; width of vein undetermined; the pay-streak, about 4′, shows chalcocite. Is driving tunnel.

**COPPER BAR MINING CO.** **WYOMING.**

Near Saratoga, Wyo. W. J. Crane, president. Has a capping of gossan 17′ wide. Property thought to have a large vein of low-grade sulphide ore below the alteration zone, which is shallow.

**COPPER BAR MINING & MILLING CO.** **NEW MEXICO.**

Office: 135 Adams St., Chicago, Ill. Mine office: Organ, Donna Ana Co., N. M. Employs 10 men. Organized 1900, under laws of New Mexico, with capitalization $1,000,000, shares $1 par. E. Percy Warner, president; Henry A. Ritter, vice-president; Henry Stephens, secretary and treasurer; C. N. Anthony, superintendent. Lands, 8 unpatented claims, area 150 acres, in the Organ Mountains, Donna Ana Co. Two lenses, contact between limestone and porphyry, being developed, showing carbonate ores and chrysocolla, averaging 14% copper, with small gold and silver values. Shafts 112′, 132′ and 177′; about 950′ underground openings. Nearest railroad, 16 miles. Company will sink and drift and install gasoline engine in 1903.

**COPPER BASIN GOLD & COPPER MINING CO.** **ARIZONA.**

Office: 43 Bank of Arizona Bldg., Prescott, Ariz. Capitalization $1,000,000. Alfred B. Noxon, president and secretary; T. W. Kyle, vice-president. Richard Lawson, treasurer. Property, 17 claims, near Prescott, Ariz. Main shaft, 140′. Property said to be well managed.

**COPPER BASIN MINING CO. COLORADO.**

At Placerville, San Miguel Co., Colo. B. B. Harlan, president, Chicago, Ill. Has 15 claims, giving good assays in copper, gold and silver. Car load of ore shipped to smelter returned 14% copper, $2 gold, $3 silver per ton.

**COPPER BELL MINING CO. MONTANA.**

Office: Milwaukee, Wis. Mine office: Clinton, Missoula Co., Mont. Property idle. Organized 1900, under laws of Washington, with capitalization $2,500,000, shares $1 par, non-assessable. W. D. Carrick, vice-president; Edw. Shea, secretary; Henry Schaeffer, treasurer; W. P. Ketcham, resident manager. Lands, 10 claims, 8 patented. Several shafts, deepest 212′; tunnel on Clinton lode, 200′; on Granite lode, 560′. Steam power. Company contemplates diamond drilling in 1903.

**COPPER BELLE MINING CO. ARIZONA.**

Office: Los Angeles, Cal. Mine office: Gleeson, Cochise Co., Ariz. Lands, 8 claims, in the Turquoise district of Cochise Co. Has a 50-ton smelter, which is a failure. Company bankrupt, and some ugly charges made regarding its management.

**COPPER BELT MINING CO. MONTANA.**

Has a group of claims in the Wallace district of Missoula Co., Mont. No returns secured.

**COPPER BELT MINING CO. UTAH.**

Office and mine: Marysvale, Piute Co., Utah. Employs 10 men. Organized 1901, under laws of Utah, with capitalization $1,000,000, shares $2 par, non-assessable. Saul Krotki, president; L. H. Bartholomew, vice-president and general manager; Elnor Bartholomew, secretary; Max Krotki, treasurer. Directors are Byron Hanchett and preceding officers. Lands, 45 unpatented claims, area 900 acres, with 20-acre mill-site, in Piute Co., showing 4 fissure veins with average width 8′, length 400′ to 1,100′, giving estimated average values of 7% copper, 8% to 55% lead, $15 gold and 40 oz. silver per ton, from sulphide ores. Has 4 shafts, deepest 400′, and tunnels of 125′, 150′ and 500′, with 1,633′ of underground openings, and 50,000 tons of ore in sight, of which 12,000 tons are blocked out for stoping. Steam power. Nearest railway, Rio Grande Western, 4 miles from mine and 4 miles from smelter site. New work contemplated for 1903 includes driving of 2,000′ of tunnels on the main vein; installation of two 100-h. p. boilers, 6-drill air compressor and drills, electric light plant, office building, boarding and lodging houses and construction of 100-ton mill. Company's claims will also be patented in 1903.

**COPPER BELT MINING CO. WYOMING.**

Near Rawlins, Carbon Co., Wyo. Lands, 12 claims, adjoining Ferris-Haggerty and Osceola. Property regarded as one of considerable promise.

**COPPER BULL MINING CO. COLORADO.**

Office: 306 Continental Bank Blk., St. Louis, Mo. Local address: L. B. 507, Pueblo, Colo. Employs 5 men. Organized 1901, under laws of Arizona, with capitalization $3,000,000, shares $1 par. Chas. R. Mason, president; Jos. Flory, vice-president; Isaac M. Mason, secretary and treasurer; Chas. O. Unfug, general manager. Directors are preceding officers and O. L.

Buddenburg, Wm. A. Rannells and Chas. W. Walters. H. S. McIntyre, superintendent. Lands, 32 claims, 3 patented, area 320 acres, near Walsenburg, Huerfano Co., Colo., showing 5 fissure veins, carrying oxide ore and said to average 7′ width with estimated value 10% copper, 4 oz. gold and 2 oz. silver per ton. Shafts, 202′ and 238′; 1,000 tons of ore blocked out for stoping. Company will continue development and hopes to begin shipping in 1903.

**COPPER BULLION MINING CO.** **ARIZONA.**

Office: 224 Byrne Bldg., Los Angeles, Cal. Mine office: Pearce, Cochise Co., Ariz. Idle. Organized 1900, under laws of Arizona, with capitalization $1,000,000, shares $1 par. Ezra T. Stimson, president; L. W. Blinn, vice-president; Percy H. Clark, secretary; Warren Gillelen, treasurer; Chas. M. Renaud, superintendent. Lands, 30 claims, in the Turquoise district of Cochise Co., showing 3 ore bodies carrying carbonate and sulphide ore, said to average 14′ in width, with 9% copper, $4 gold and 7 oz. silver per ton. Has 4 shafts, deepest 210′, and tunnels of 80′ and 900′.

**COPPER BUTTE MINING CO.** **SOUTH DAKOTA.**

Supposed to be located near Custer, S. D. No returns.

**COPPER CANON MINING CO.** **NEW MEXICO.**

At Abiquiu, Rio Arriba Co., N. M. J. E. Irvine, superintendent. Was prospecting with small force at last accounts.

**COPPER CANYON MINE.** **BRITISH COLUMBIA.**

A property at the foot of Mount Sicker, British Columbia, opened by two tunnels, on 4′ vein showing rich ore. No returns secured.

**COPPER CAVE MINING CO.** **WYOMING.**

Property in the vicinity of Saratoga, Carbon Co., Wyo.; no returns secured.

**COPPER CENTER GROUP.** **MEXICO.**

A group of claims near Moctezuma, Sonora, Mex., on which some development work has been done by Dew R. Oliver, of San Francisco, Cal.

**COPPER CHIEF MINING CO.** **ARIZONA.**

At Jerome, Yavapai Co., Ariz. Arthur Hendey, superintendent. Has copper-gold-silver ores, opened by shaft. Equipped with steam power and leaching plant. Employed about 20 men at last accounts.

**COPPER CHIEF MINING CO.** **MONTANA.**

Office: 526 Peyton Blk., Spokane, Wash. Incorporated 1902. H. A. Fosselman, president; J. W. Phillips, secretary. Lands, at Silver Star, Madison Co., Mont. No returns secured.

**COPPER CHIEF MINING CO.** **NEW MEXICO.**

Office: 509 Main St., Lafayette, Ind. Mine office: Kenton, Oklahoma. Employs 10 men. Organized 1901, under laws of New Mexico, with capitalization $500,000, shares 50 cents par, non-assessable. Relief Jackson, president; Noah Justice, vice-president; Edgar H. Andress, secretary and treasurer; Jared Sater, superintendent. Lands, 10 claims, area 200 acres, in Black Mesa district of Union Co. N. M. Company states that ledge underlies entire tract, having average width 1,800′, length 6,000′, depth 100′, with estimated average value 3% copper, $2 gold and 50 oz. silver per ton. Ores, oxide, carbonate, silicate and sulphide. Has 250′ tunnel with large amount of ore blocked out. Has concentrating plant and will use volatilization process. Contemplates building a mill, extending tunnel and drifting, in 1903.

**COPPER CLIFF MINING CO. ARIZONA.**

Property sold to the Catalina Mining Co.

**COPPER CLIFF MINING CO. MONTANA.**

Office and mine: Cliff, Powell Co., Mont. Idle. W. P. Shipler, superintendent. Lands, 4 claims, area 80 acres, showing contact veins of good width, with oxide, carbonate and sulphide ores, said to assay 10% copper and $10 gold per ton. Has 200′ shaft and tunnels of 300′, 500′ and 800′. Contemplates extension of tunnel, addition of compressor and drills and erection of 50-ton smelter in 1903.

**COPPER CLIFF MINING CO. SOUTH DAKOTA.**

Mine office: Rochford, Pennington Co., S. D. Organized 1899, under laws of South Dakota, with capitalization $1,000,000, shares $1 par. D. F. Brazee, president; Chas. A. Fohrman, vice-president and general manager; E. W. Eldridge, secretary. Property carries copper ore and graphite; company said to be mining the latter and making paint in a suburb of Chicago.

**COPPER COBRE MINE. ARIZONA.**

The mine with this tautological title is in the Bradshaw Mountains, Yavapai Co., Arizona. G. W. Middleton, manager. No returns secured.

**COPPER COMPANY OF BRITISH COLUMBIA, LTD. BRITISH COLUMBIA.**

Offices: 11, Grocers' Hall Ct., London, E. C., Eng. Was formed to acquire copper mines in the East Kootenai district, B. C. No returns and company apparently moribund.

**COPPER CORPORATION OF CHILI, LTD. CHILE.**

In voluntary liquidation; J. Peters, St. George's House, Eastcheap, London, E. C., Eng., liquidator. Efforts are being made to reorganize. Principal mining property is the Chañaral, in the department of Chañaral, Chile, which produces about 1,000 tons yearly. Company also owns the Fortunata mine, 430′ deep, opened 1855, at Las Animas, Chañaral, Chile.

**COPPER CREEK CONSOLIDATED CO. ARIZONA.**

Lands, somewhere in Arizona. No address secured.

**COPPER CREEK CONSOLS, LTD. BRITISH COLUMBIA.**

Main office not located; letter addressed to company at Ashcroft, B. C., returned unclaimed, October, 1902. Property said to be on Criss Creek, Ashcroft mining division, B. C., and difficult of access. Vein 3′ to 4′ wide, assaying under 2% copper, with 17 oz. silver per ton.

**COPPER CROWN MINING CO. MICHIGAN.**

Office: presumably in St. Louis, Mo. W. R. Hopkins, secretary and general manager. Has recently purchased the Hamilton group, area 400 acres, adjoining the Norwich mine, Ontonagon Co., Mich., on which a little mining work was done many years ago. New owners are understood to contemplate development.

**COPPER CROWN OF ARIZONA MINING CO. ARIZONA.**

Office: 13 South Seventh St., Minneapolis, Minn. Mine office, Pearce, Cochise Co., Ariz. Is employing 10 men. Organized, 1900, under laws of Arizona, with capitalization $2,000,000, shares $1 par, non-assessable. Thos. W. Stevenson, president; C. F. Potter, Jr., secretary; F. J. Peterson, treasurer; preceding officers, W. L. Stevenson, E. C. Garwood, S. Finkleson and F. N. Wolcott, directors; Chas. F. Potter, general manager; Wm. Buckland, superintendent. Lands, 17 claims, area 340 acres, also 20-acre millsite and 10-acre smelter-site, in the Dragoon district of Cochise Co. Has 3 main veins, assaying 5% to 40% copper, with a little gold and silver, ores being oxide, carbonate and sulphide. Shaft, 275′; tunnels of 50′ and 75′; upwards of 1,000′ underground openings; will continue development work in 1903.

**COPPER CROWN OF NOVA SCOTIA MINING CO. NOVA SCOTIA.**

Office: 373 Washington St., Boston, Mass. Organized under West Virginia laws, with capitalization $1,000,000, shares $1 par. Samuel K. Paige, president; Geo. B. Holden, secretary and treasurer; W. H. Kennan, manager. Lands, near Pictou, N. S. Claims to have extensive ore bodies averaging 5% to 6% copper. Has smelter, with blast furnaces of 300 tons and reverberatory furnace of 70 tons daily capacity, located with tidewater in front and railroad tracks behind. Fuel and flux abundant and cheap. No returns secured and property thought to be idle.

**COPPER DUKE MINE. MONTANA.**

Near Copperopolis, Meagher County, Montana. Said to be under bond and lease to Butte parties.

**COPPER ESTATES OF WESTERN AUSTRALIA, LTD. AUSTRALIA.**

Offices: 66, Finsbury Pavement, London, E. C., Eng. No returns from company and no particulars regarding property from Western Australia.

**COPPER FALLS MINE. MICHIGAN.**

Once a dividend payer. Absorbed by Arnold in 1898.

**COPPERFIELD MINES. VERMONT.**

Office: 820 Pennsylvania Ave., Pittsburg, Pa. Mine office: Copperfield, Orange Co., Vt. Employs 200 men. Owned by Geo. Westinghouse, Pittsburg, Pa. Geo. J. Troop, Jr., general manager and superintendent; Geo. C. Everett, mill superintendent; Wm. Ricker, mining captain. Ore body is of good size and strength, yielding a rather low grade disseminated chalcopyrite. Main shaft, 3,700′ deep, on incline of 23°, giving vertical depth equal to 1,500′. Has tunnel of 1,000′, leading from 300′ level to wash house. Complete steam equipment. Smelter, three quarters of a mile from shaft, receives ore by gravity tram. Smelter has 2 water-jacket blast furnaces, reverberatory furnace and stand of converters, installed 1902, by Colorado Iron Works Co. Product turned out as blister copper, 98% to 99%. Nearest railroad, Boston & Maine, 9 miles; railroad station, Ely, Vt. This property was formerly known as the Ely mine, and was worked on a considerable scale previous to the Civil War. Was reopened by present owner in 1900. Property thought to be giving satisfactory returns.

**COPPER FIELDS OF NAMAQUALAND, LTD. CAPE COLONY.**

Offices: 10, St. Helen's Place, London, E. C., Eng. A. Crump, chairman;

N. A. Eustace, secretary. Owns 354 acres of land in Little Namaqualand, Cape Colony, South Africa. Is negotiating for sale of lands.

**COPPER GIANT GOLD & COPPER MINING CO. WYOMING.**

Office: Encampment, Carbon Co., Wyo. Property presumably in vicinity. D. Frank Powell, president; P. H. Kennedy, secretary. Property has been idle some time, but it is understood that Col. W. F. Cody furnished sufficient funds for resumption of work, late in 1902.

**COPPER GLANCE MINING CO. ARIZONA.**

Office and mines: Bisbee, Cochise Co., Ariz. Is employing 30 men. Organized 1901, under laws of Arizona, with capitalization $2,500,000, shares $1 par, non-assessable. S. W. Clawson, president; C. C. Warner, vice-president and superintendent; G. E. Tomlinson, secretary; Jas. Wood, treasurer; C. L. Beckwith, general manager. Property, 24 claims, patents now being taken out, area 400 acres, in the Warren district of Cochise Co., Ariz. Ores occur as carbonates and sulphides, in lenses of unknown dimensions, but apparently of considerable size. Estimated average value of ore, 18% copper, $1 gold and 22 oz. silver per ton. Has 4 main shafts, deepest 140′ and 525′. El Paso & Southwestern R. R. crosses the property. Will continue development work vigorously in 1903, program including installation of power pumps and hoists; sinking 2-compartment shaft to about 1,000′, also deepening No. 4 shaft; crosscutting, drifting and erecting 10 dwellings. Company is in good financial condition and in charge of mining men of experience and good standing.

**COPPER GLANCE MINING CO. NEW MEXICO.**

Was operating near Taos, Taos Co., N. M., several years ago; no returns secured; company probably moribund.

**COPPER GLANCE MINING & MILLING CO. WYOMING.**

Office: Chicago, Ill. Geo. Garoutte, general manager. Was sinking shaft in ore assaying 20% copper, with fair gold values, late in 1902.

**COPPER GLOBE MINING CO. UTAH.**

In the southeastern part of Emery Co., Utah. Title in dispute between Dr. C. B. Snyder of Provo, Utah, and Dr. W. R. Rice of St. George, Utah. Has large bodies of low-grade copper ore; affairs in litigation for about two years.

**COPPER-GOLD MINING CO. WASHINGTON**

At Bossburg, Stevens Co., Wash. S. G. Wilson, superintendent. Has argentiferous and auriferous copper ores, with limited development. Small force employed at last accounts.

**COPPER-GOLD MINING & MILLING CO. WYOMING.**

Near Hecla, Carbon Co., Wyo. Jos. O. Majors, superintendent. Was developing with small force at last accounts.

**COPPER HILL MINE. CALIFORNIA.**

In Amador County, Cal. Idle. Owned by W. F. Detert, Jackson, Cal. Mine opened, circa 1861, and worked about 20 years, with considerable production. The vein formation, quartz porphyry, is 500′ to 600′ wide, with heavy gossan capping, and carries chalcopyrite and iron pyrites.

**COPPER HILL MINING CO.** **ALABAMA.**

Mine at Stone Hill, Cleburne County, Ala. Once known as the Woods mine. Now idle. Opened 1870 and worked as many as 500 men. Had a smelter, circa 1876–79; closed latter year; owing to exhaustion of high-grade altered ores, after producing copper valued at $1,300,000. Has a 24′ vein, mineralized near walls to extent 3% to 7% copper.

**COPPER HILL MINING CO.** **ARIZONA.**

Mines near Oracle, Ariz. Company purposes installing 100-ton leaching plant and building wagon road 24 miles to Red Rock station, nearest railroad point, and transporting ores from the mine to Red Rock by traction engine. Said to have a half million tons of carbonate and silicate ores blocked out in mine.

**COPPER HILL MINING CO.** **NEW MEXICO.**

Office: 1 Madison Ave., New York. Mine office: Rinconada, Taos Co., N. M. Organized under laws of West Virginia, with capitalization $1,000,000. Dr. P. M. Wise, president; S. L. Phillips, secretary; J. K. Turner, general manager. Lands, in Mammoth district of Taos county. Ores carry gold, silver and copper; developed by shaft and tunnel; steam and electric plant and 75-ton concentrator.

**COPPER HILL MINING & MILLING CO.** **WASHINGTON.**

Office: 504 Empire Bldg., Spokane, Wash. Mine office; Newport, Stevens Co., Wash. Organized 1899, with capitalization $75,000, shares 5 cents par. F. J. Heller, president; G. O. Nettleton, secretary. Lands, 60 acres. Has shaft 230′ and tunnel 260′ in vein 18′ wide, showing chalcopyrite. No returns secured for 1902.

**COPPER INDEPENDENT CONSOLIDATED MINING CO.** **WASHINGTON.**

Office: 61 Court St., Boston, Mass. Mine office: Silverton, Wash. Capitalization $3,000,000, shares $1 par. M. V. Little, president; E. P. Crooker, secretary; Arthur W. Hawks, general manager. Has fissure vein in granite, showing gold and arsenopyrite. Vein strong, and mineralization uniform; ore requires concentration. Has small steam plant; no returns secured.

**COPPER KING MINES.** **ARIZONA.**

Near Johnson, Cochise Co., Ariz. S. A. D. Upton, owner. Was prospecting, with small force, at last accounts.

**COPPER KING CLAIM.** **BRITISH COLUMBIA.**

Sixteen miles west of Kamloops, B. C. Has secured assays 5% to 20% copper, one-half to 1 oz. gold, and 1 to 6 oz. silver per ton.

**COPPER KING MINE.** **OREGON.**

In the vicinity of Comer, Oregon; no returns secured.

**COPPER KING MINES.** **SOUTH DAKOTA.**

In the vicinity of Terry, S. D.; no returns secured.

**COPPER KING MINE.** **WASHINGTON.**

Near Chewelah, Stevens Co., Wash. Prospecting with small force at last accounts.

**COPPER KING MINE.** **WYOMING.**

Near Tie Siding, Carbon Co., Wyo. W. C. Lynde, superintendent. Employed small force at last accounts.

**COPPER KING, LTD.** **CALIFORNIA.**

Offices: Basildon House, London, E. C., Eng. F. L. Gardner, chairman; W. H. Daily, general manager; W. Bramall, secretary; Geo. S. Tyler, superintendent. Is working about 100 men. Property is the Copper King mine, area 90 acres, on Dog Creek, 27 miles from Fresno, Fresno Co., Cal., and smelter at Seal Bluff Landing, on Suisun Bay, near Martinez, Cal. Mine opened on schistose vein about 100′ wide, all mineralized, but with pay streak 2′ to 20′ carrying carbonate, oxide and sulphide ores, the latter exclusively in the deeper workings. Has one main shaft, 450′ deep, also 2 air shafts. Ore is hauled 17 miles by traction engines to Deering, thence by rail to smelter. Mine is operated by electric power generated from steam made by crude petroleum. Has a concentrator and other necessary buildings and shops, all new and of good size. Smelter is known as the Pacific Coast Smelting & Refining Works, and has both rail and tidewater connections, using electric power, generated with crude oil as fuel. Smelter has two 50-ton McDougal roasting furnaces for pyritic smelting, also a 100-ton reverberatory furnace using crude petroleum for fuel, and converters. Ores assay about 7% and product is turned out as high-grade blister copper. Blast furnaces are being added to the plant, which will have a daily capacity of 300 tons and will do general custom smelting in addition to treating its own ores.

**COPPER KING MINING CO.** **BRITISH COLUMBIA.**

At Cameron Lake, Nanaimo district, B. C. Drove 100′ tunnel and tapped a copper vein in 1901; no later returns secured.

**COPPER KING MINING CO.** **MONTANA.**

Supposedly in Missoula Co., Montana, but exact address unobtainable; probably idle.

**COPPER KING MINING CO.** **OREGON.**

Incorporated August, 1902, with capitalization $1,500,000, at Pendleton, Ore. Letter to company returned undelivered.

**COPPER KING MINING CO.** **UTAH.**

Office: Summit & Cherry Sts., Toledo, Ohio. Mine office: Brigham City, Box Elder Co., Utah. Henry C. Baker, president, Ogden, Utah. Company in litigation, November, 1902, and likely to lose property through defective title.

**COPPER KING MINING CO.** **WASHINGTON.**

At Sumas, Whatcom Co., Wash. R. S. Lambert, superintendent. Has steam power and was working small force at last accounts.

**COPPER KING MINING & MILLING CO.** **WASHINGTON.**

Organized under laws of Washington. Geo. R. Trask, president, and Sam Hanauer, secretary, in 1898. No trace of company found after protracted investigation.

**COPPER KING MINING & SMELTING CO.** **IDAHO.**

Supposed to be in the vicinity of Mullan, Idaho, but no returns secured.

**COPPER KING MINING SYNDICATE.** **WASHINGTON.**

Office: Tacoma, Wash. R. E. McFarland, president; R. E. Areith, secretary and treasurer; D. E. Guiley, superintendent. Capitalized at

$10,000,000. Has 64 claims in Pearce Co., Wash., in a district said to be rich but not easily accessible.

**COPPER KING OF ARIZONA MINING CO. ARIZONA.**

Office: 116 Nassau St., New York, N. Y. Mine office: Pearce, Cochise Co., Ariz. E. Boitel, president; Thos. F. Gaynor, secretary and treasurer; Thos. F. O'Brien, superintendent. Organized 1895, with capitalization $5,000,000, shares $1 par. Was promoted by the late B. C. Davis, who peddled stock assiduously, making large promises, none of which were redeemed. Operations begun near Copper Queen mine at Bisbee, thence transferred to Barrett, Ariz.; operating latterly near Pearce. Said to have a small smelter. No returns secured.

**COPPER KNOB MINE. NORTH CAROLINA.**

A property at New River, Ashe County, N. C., on which considerable work was done in early days. Ores are of great variety, and carry considerable gold values. Idle for some years.

**COPPER MINES OF MOUNT LYELL WEST, LTD. TASMANIA.**

Offices: 16, St. Helen's Place, London, E. C., Eng. Organized 1897, under laws of Tasmania, with capitalization £400,000, shares £1 par, non-assessable; £230,000 issued. Chas. McCulloch, chairman; H. A. H. Russell, secretary; A. G. Ogilvie, general manager. Lands, 70 acres, in Mt. Lyell district of Montague Co., showing several ore bodies of large width, assaying 3% to 7% copper, with traces of gold and silver. Considerable ore bodies have been opened by 2 tunnels. Is not yet a producer.

**COPPER MOUNTAIN DEVELOPMENT CO. CALIFORNIA.**

Office: probably Fresno, Cal. J. B. Campbell, president; R.McCourt, superintendent. Has 50 claims, area about 1,000 acres, 35 miles east of Kaweah, Tulare Co., Cal. Mines opened July, 1900. Ores are carbonates and sulphides, carrying 2% to 25% copper. Has a limited amount of development work.

**COPPER MOUNTAIN MINING CO. CALIFORNIA.**

W. A. Cooper, San Bernardino, Cal., president. Has 10 claims near Victor, San Bernardino Co., Cal. One claim shows gossan outcrop 200′ wide. Ore, mainly sulphide, said to run 8% to 10% copper. Opened, circa 1873; reopened 1901. Has 200′ shaft. Limited amount of development work done on the Amazon, Hecla and Queen claims.

**COPPER MOUNTAIN MINING CO. NEVADA.**

Near Tecoma, Elko Co., Nev. D. Kane, superintendent. Developing by shaft and tunnel, with steam power; about 20 men employed at last accounts.

**COPPER MOUNTAIN MINING CO. SOUTH DAKOTA.**

Near Sheridan, S. D. S. A. Baxter, Lima, Ohio, president; John Good, superintendent. Company considering erection of 100-ton smelter at last accounts.

**COPPER MOUNTAIN MINING CO. WYOMING.**

Has claims on Copper Mountain, 20 miles southeast of Big Horn, Wyo.

Said to have a 6″ vein of ore assaying 40% copper, $15 gold and 517 oz. silver per ton.

**COPPER MOUNTAIN MINING & DEVELOPMENT CO. WASHINGTON & BRITISH COLUMBIA.**

Office: 5,406 Union Ave., South Tacoma, Wash. Has properties in Washington and British Columbia. Capitalization, $200,000, shares 10 cents par. S. B. Cowles, president; S. T. Lewis, vice-president; Jos. Hutchinson, secretary; F. W. Walcott, treasurer; preceding officers, F. G. Kellogg, Thos. M. Stack and Thos. H. Falconer, directors; B. D. Holcomb, general manager. The Washington property, at Ryan, Stevens Co., is idle. Has 4 claims of 90 acres, with 3 ore bodies; one lens 75′ wide opened by 300′ shaft and 115′ tunnel; has steam power equipment. Crosscuts will be driven on this property in 1903. The property at Quatsino Sound, B. C., is employing 10 men. A. T. Macaulay, superintendent. Has 5 claims, area 258 acres, showing an ore body said to be 100′ wide, with measured length of 3,000′, assaying 6% to 8% copper, $2 gold and 3 oz. silver per ton. A large amount of ore is shown on surface and deposit will be worked open-cast; possibly a shaft will be sunk also. Ore will be treated by the new smelter of the Yreka Copper Company, 7 miles distant.

**COPPER MOUNTAIN MINING & MILLING CO. UTAH.**

Office: 323 D. F. Walker Bldg., Salt Lake City, Utah. Benj. T. Lloyd, secretary, treasurer and general manager. Property in Beaver Co., Utah. Has 100′ shaft, with 250′ incline running from bottom, showing vein, 4′ to 14′ of ore, assaying 18% to 28% copper.

**COPPEROPOLIS COPPER CO. OREGON.**

Office: 538 Chamber of Commerce, Portland, Ore. Mine office: Quartzburg, Grant Co., Ore. Employs 10 men. Organized 1900, under laws of Oregon, with capitalization $120,000, shares 10 cents par. A. H. Willett, president; A. W. Dunn, vice-president; W. W. Gibbs, secretary, treasurer and general manager. Lands, 2 patented claims, area 40 acres, also 5-acre millsite, showing 4 fissure veins, with estimated average values 12% copper, $15 gold and 3 oz. silver per ton. Ores, carbonate and sulphide. Has tunnels of 75′ and 400′. Steam, water and electric power. Will continue development work in 1903.

**COPPEROSITY MINE. ARIZONA.**

At Vekol, Pinal Co., Ariz. E. J. Bonsall, superintendent. Has shaft and tunnel; small force employed at last accounts.

**COPPER PRINCE GROUP. ARIZONA.**

Is developing copper claims in the Eureka district of Yavapai Co., Ariz. Colin Timmons, superintendent.

**COPPER PRINCE MINE. ARIZONA.**

At Kingman. Mohave Co., Ariz. J. W. Smith, superintendent. Has shaft and tunnel, with gasoline power; was working small force at last accounts.

**COPPER PRINCE MINING CO. CALIFORNIA.**

E. Lobree, president; J. C. Ruddock, secretary, Ukiah, Cal. Property, 3 claims, near Middletown, Lake Co., Cal. Opened by tunnel and trenches. Vein, 6′ to 8′, in limestone, assaying 5% copper, $3 gold and 1 oz. silver per ton.

**COPPER QUEEN CLAIMS. ARIZONA.**

At Stoddard, Yavapai Co., Ariz. Wm. Park, superintendent. Ores opened by tunnel show copper and gold values. Was prospecting with small force at last accounts.

**COPPER QUEEN GROUP. IDAHO.**

Twelve claims in the Blackbird district of Lemhi Co., Idaho, under option to eastern syndicate at sum said to be $100,000. Said to show 8′ vein, assaying 27% copper and $8 gold per ton.

**COPPER QUEEN, LTD. BRITISH COLUMBIA.**

Offices: 11, Ironmonger Lane, London, E. C., Eng. Property originally owned, which was the Copper Queen group in the Nelson district, West Kootenay, B. C., has been abandoned.

**COPPER QUEEN CONSOLIDATED MINING CO. ARIZONA.**

Office: 99 John St., New York. Mine office: Bisbee, Cochise Co., Ariz. Employs a large force and is one of the world's greatest copper producers. Organized 1885, under laws of New York, with capitalization $2,000,000. Jas. Douglas, president; Jos. Van Vleck, vice-president: Geo. Notman, secretary and treasurer. Directors are preceding officers, Wm. E. Dodge, D. Willis James, C. H. Dodge and A. C. James. Walter Douglas, general manager; S. W. Clawson, general superintendent; Jas. Wood, smelter superintendent. Mining lands are very extensive and underground development is equally large, mine being said to have upwards of 100 miles of underground openings. The Lowell property, recently bought, has shown a good ore body, late in 1902.

The formation of the Copper Queen, and of the other mines in the Bisbee district, consists essentially of two limestone beds, the upper white and the lower blue, of Carboniferous age, and dipping to the southward, these flanking a granite core. The most important finds of ore have been at the base of the upper limestone, which is broken and interrupted by feldspathic igneous rocks, the latter evidently having a considerable bearing on the ore bodies, which are lenses, very erratic in habits, the existence of which cannot be forecast with any degree of certainty. Developments of the past year or two have shown that the formation carries extensive ore values much deeper than was formerly supposed. There are some very interesting caves in the limestone, of practical interest because good ore bodies always have been found beneath them. The alteration zone is variable, running to 200′ in places, though rich oxidized ores have been found in the very lowest workings. Azurite and malachite are found in considerable quantities, also a lesser amount of cuprite and some native copper, the latter almost invariably associated with the cuprite. The largest masses of native metal, ranging up to several cwts. in size, have not been found near the surface, as would be anticipated, but at considerable depth.

The mine has pushed prospecting and development work continuously for many years, and at the close of 1902 is sinking a shaft on a group of 14 claims in the Gold Gulch district, and another shaft on the White Tail Deer group, next to the Lake Superior & Pittsburg Development Co's property. The entire hill is creeping and great care is required in securing the mine openings. The mine is timbered with square sets of 10x10" and 12x12" timbers, mainly of Washington fir, and an average of 30' of timber, board measure, is required for each ton of ore won. The ore is rough-sorted underground, after breaking, and culls used for filling in worked-out stopes, this material standing remarkably well.

The mine is thoroughly equipped with steam, gasoline and electric power. The old smelter at the mine has 5 furnaces, using a blast pressure of 7 pounds per inch, and turning out 45% matte. The furnaces are oval water-jacket cupolas, 42x120" each, with two tilting wells, set tandem, slag flowing from the second well into 2-ton ladles, thence to 4-ton slag cars drawn to the slag dump by a dummy engine. Converters are of the horizontal barrel type, 5' 6" diameter by 8' long. Product is turned out as blister copper, averaging 99%.

The company is building a new smelter at Douglas, 25 miles southeast of Bisbee and very near the Mexican border. This will have a daily capacity of 1,500 tons as against 1,000 tons at the old smelter, and is assured an ample water supply. The new smelter will be fitted with every appliance for labor saving and economical work.

The Copper Queen was opened in 1880 and has gradually grown to its present position among the world's largest mines. Production for 1901 was 39,781,333 pounds and for 1902 is estimated by the company at 35,000,000 pounds.

**COPPER QUEEN CONSOLIDATED MINING & MILLING CO.**

Office: 500 Auerbach Bldg., Salt Lake City, Utah. No returns secured.

**COPPER QUEEN MINING CO.**

Office: 542 The Rookery, Spokane, Wash. Location of property unknown and no returns secured.

**COPPER QUEEN MINING CO, LTD.** **ONTARIO.**

Office: Sault Ste Marie, Mich. Is employing 12 men. Organized 1902, under laws of Ontario, with capitalization $3,000,000, shares $10 par, nonassessable. W. L. Murdock, president; R. G. Ferguson, vice-president; R. N. Adams, secretary and treasurer; David Brown, general manager; preceding officers, Jos. Willmes, Jos. Hermann, and M. N. Hunt, directors; W. F. Ashton, mining captain. Lands, 960 acres, in Algoma, Ontario, having fissure vein said to be 70' wide and traceable 3 miles, showing chalcopyrite. Has 3 shafts, deepest 135', and 2 tunnels, longest 195'. Nearest railroad, 13 miles. Company will continue development and install machinery in 1903.

**COPPER RANCH MINING CO.** **UTAH.**

Office: 323 D. F. Walker Bldg., Salt Lake City, Utah. Mine office: Milford, Beaver Co., Utah. Organized under laws of Utah, with capitalization $500,000, shares 50 cents par. Moses Thatcher, president; C. L. Rood, vice-president; Benj. T. Lloyd, secretary and treasurer. Company has no bonded or other indebtedness. Lands, 17 claims, area 340 acres, lying between the Old Hickory and O. K. mines of the Majestic Co., and carrying about 2 miles of outcrop along the strike of the vein, which is about 100′ wide and has been developed, at intervals, for a distance of about one mile. Assays have ranged 7% to 43% copper, $2.25 to $8 gold and 7 to 10 oz. silver per ton. It is estimated that the entire vein will average 4% to 7% copper, with fair gold and silver values. Company purposes installing a concentrator or smelter in 1903, but is undetermined as to which. Property regarded as valuable.

**COPPER RANGE CONSOLIDATED CO. MICHIGAN.**

Office: 27 State St., Boston, Mass. Organized November, 1901, under laws of New Jersey, with capitalization $28,500,000, in 285,000 shares, par $100. Wm. A. Paine, president; Frederic Stanwood, secretary and treasurer; Wm. A. Paine, John Stanton, Kenneth McLaren, Cameron Currie, Samuel L. Smith, J. Henry Brooks, Chas. H. Paine, Frederic Stanwood and E. B. Maltby, directors.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,549,550.00 |
| Amount paid in by conveyance of property to company | 750,000.00 |
| Entire amount invested in real estate | 1,301,944.19 |
| Amount of personal estate | 3,134,500.00 |
| Amount of unsecured or floating debt | 10,000.00 |
| Amount due the corporation | 2,040.16 |

The Copper Range Consolidated is strictly a securities company, controlling various subsidiary corporations through stock ownership. This company owns practically the entire stock issues, except the necessary founders shares, of the Baltic Mining Company, Copper Range Company and Copper Range Railroad Company, and one-half the capital stock of the Champion Copper Co. The Baltic and Champion properties are fully described elsewhere, under their respective titles. The Copper Range Railroad Company and the Copper Range Company will be treated of in this article.

The holdings of the Copper Range Co. originally included nearly 10,000 acres of lands on the mineral belt south of the Baltic mine, in Houghton county, Michigan. From this tract the Champion mine was set off, the Copper Range Co. and St. Mary's Canal Mineral Land Co. furnishing equal areas for the Champion property. The present landed holdings of the Copper Range Co. consist of 8,720 acres, located in a compact tract in Town 54 North, Range 34 West, and Town 54 North, Range 35 West, something more than 5,000 acres of this tract being located on the mineral belt. The company also holds a long-term option on 2,000 acres of mineral land owned by St. Mary's Co., which can be drawn on at will. There is also a millsite of 441 acres at the mouth of the Graeverat river, Lake Superior, 3 miles southwest of the Champion mill.

The Copper Range Railroad Company was organized in 1899 with an authorized capital of $5,000,000, of which $1,350,000 is issued. There is an outstanding issue of $1,020,000 bonds, at 5%, running 50 years, secured by a first mortgage to the American Loan & Trust Co. of Boston. Additional bonds may be issued at the rate of $20,000 per mile of completed main line and $15,000 per mile of completed branch lines and side tracks. Directors of the Copper Range Railroad Co. are Wm. A. Paine, S. L. Smith, Cameron Currie, F. McM. Stanton, R. R. Goodell, J. H. Rice, J. H. Seager, Frederic Stanwood and E. B. Maltby.

The business of the railroad for 1900, its first year of operation, was $83,941 gross and $6,405 net; for 1901 the business was $133,201 gross and $25,401 net; for the first six months of 1902 the business was $140,305 gross, earnings of July 1902 being $28,172 gross and $14,573 net. Gross business for 1903 should approximate $500,000, with good net earnings.

The Copper Range main line runs 41 miles from Houghton to Mass City, Ontonagon county. The producing mines on this line are the Atlantic, Baltic, Trimountain, Champion, Adventure and Mass. The Atlantic has its own railway, and the Mass business goes to the Mineral Range railway, but the other mines named are served by the Copper Range. Connections are with the C., M. & St. P. at Mass City and the D., S. S. & A. and Mineral Range roads at Houghton. An extension of 16 miles from Houghton to Calumet, via Lake Linden, was begun in 1902, and will be in operation early in 1903. The log and lumber traffic between the forests of the "South Range" and the mines of Calumet will alone afford net earnings to pay interest on the cost of this extension. In addition to the main line there are two principal branches; the Painesdale, serving the Baltic, Trimountain and Champion mines, and the Lake Shore, which serves the mills along Lake Superior. There are also spur tracks to the Adventure and several other mines.

The railroad owns very valuable and extensive water frontage on Portage Lake, in the western part of Houghton, also a half interest in the railroad bridge across Portage Lake. The water frontage is partly improved with large and well-built merchandise and coal wharves. The road handled about 75,000 tons of bituminous coal for South Range mines in 1902, and should double that traffic in 1903. The coal wharf is supplied with coal hoists and sheds among the best on the great lakes. The rock tonnage of the road for 1903 is estimated as likely to average 7,000 tons daily, affording a gross annual revenue of $300,000, the Baltic, Trimountain and Champion mines being scheduled to furnish 2,000 tons each, daily, with 1,000 tons from the Adventure. The road has added extensively to its locomotive and car equipment, during 1902, and has brought its roadbed to first-class condition. R. T. McKeever is general manager of the railroad, which has its general offices in its own building at Houghton. This railroad has made possible the development of vast wealth in mines, timber and arable lands that were utterly inaccessible before its construction, and the territory along the line is already populated by thousands of people, where dozens only were found before its construction. Baltic, Trimountain, Painesdale and Greenland are already thriving towns of upwards of a thousand souls each, and no great stretch of imagination is required to foresee the erstwhile wilderness between the Atlantic mine and the Ontonagon river populated by 50,000 busy and prosperous people, within the next two decades. The present prosperity of all the Copper Range Consolidated Company's various enterprises is fully deserved, for the population, business and wealth within its domain have been created outright in some cases, and rendered possible in others, by the far-sighted operations of this corporation and its subsidiary companies.

**COPPER RIVER COPPER CO.** **ALASKA.**

Address: care of Jas. Shirley, Waldorf-Astoria, New York. Local office: Valdes, Alaska. Mine office; Eagle City, Alaska. Capitalization supposed to be $50,000,000. Promoters of company said to be Jas. Shirley, Fredk. J. Abbott, F. C. Bradshaw, F. Helm, and others. Lands, 760 acres, near Eagle City, 130 miles north of Valdes, in the interior of Alaska. Some of the most ridiculous statements ever appearing in print have been published regarding this property, but who should be held responsible for the lies is not apparent. One of these remarkable newspaper articles stated that the Calumet & Hecla was asking on bended knees to be allowed the privilege of consolidating with the Copper River Copper Co. and the Garretson Pyritic Furnace Co. Inasmuch as the Calumet & Hecla has no sulphide ores, a pyritic furnace could not possibly be used for smelting.

The Copper River copper belt is said to be about 50 miles long. Definite information is lacking regarding ores and values, most of the statements in print regarding same being palpably untrue. In fact the matter printed regarding this property is phenomenally foggy and contradictory. One version is that the copper is carried in an amygdaloid with a limestone contact, which is not especially probable. Newspaper estimates of $15,000,000 in ore values exposed on surface are ridiculous.

The Copper River Copper Co. is said to have financed the Alaska Central R. R., to run 400 miles from Valdes to the Arctic circle. Is said that the company floated bonds for $40,000 per mile on 400 miles, giving a $16,000,000 bond issue, sold at 80% of face, or $32,000 per mile, to a London syndicate, and that a contract for the building and equipment of the road, including all rolling stock, has been let for $26,000 per mile to J. B. McDonald & Co. of New York.

**COPPER ROCK GOLD MINING & MILLING CO.** **COLORADO.**

Office: 802 Wainwright Bldg., St. Louis, Mo. Mine office: Sunset, Boulder Co., Colo. Capitalization, $1,500,000. H. Lee Servoss, president; Dan G. Kirshbaum, secretary and superintendent. Lands, 60 acres, 40 miles northwest of Denver. Shaft, 300′ deep at last accounts. Ores carry copper, gold and silver; good assays have been secured.

**COPPER STAR MINING CO.** **COLORADO.**

Office: 60 State St., Boston, Mass. Mine office: Salida, Colo. Capitalization, $500,000, shares $1 par. Eugene B. Estes, president; Edwin Wallace, secretary and general manager. Lands, about 180 acres. Company began paying dividends of 2 cents per share while selling stock at $1 per share—

a very questionable policy. No returns secured and present status of company unknown.

**COPPERTOWN MINING CO.** **CALIFORNIA.**

Office: San Francisco, Cal. Is developing La Victoria mine, near Hornitos, Mariposa Co., Cal. C. H. Street, superintendent. Has 3 shafts, each about 200′, also 400′ tunnel; employs about 20 men, Vein matter 300′ to 600′ wide, of schistose diabase, between grano-diorite walls, showing malachite, azurite, cuprite, bornite and tetrahedrite, with heavy gossan capping. All ores, including the gossan, are more or less auriferous. Was once a considerable producer, employing 300 men, circa 1865. Company contemplates installing a smelter.

**COPPER VENTURE SYNDICATE, LTD.**

Offices: 10, St. Helen's Place, London, E. C., Eng. Cannot be found that company owns copper property.

**COPPER WORLD MINE.** **NORTH CAROLINA.**

Located in Virgilina district of Person Co., N. C. Operated by Danville, Va., parties. Has two shafts, deepest 100′, in vein of fair width, giving chalcocite, oxide and carbonate ores, ranging 15% to 65% in tenor.

**COPPER WORLD MINES.** **CALIFORNIA.**

Office: Wilcox Blk., Los Angeles, Cal. Geo. H. Sisson, president; Geo. D. Copeland, secretary; E. M. Clark, superintendent. Lands, in the Clark mining district, 37 miles northwest of Manvel, San Bernardino Co., Cal. Property carries considerable lenses of oxide ore, between porphyry and limestone, these averaging 12% to 15% copper. Has about 3,000′ of shafts and tunnels. Has 50-ton water-jacket blast furnace at Bailey Wells, 5 miles from mine. Company was in sore financial straits at last accounts.

**COPPER WORLD MINING CO.** **WASHINGTON.**

At Loomis, Okanogan Co., Wash. John Wentworth, superintendent. Developing by tunnel, with small force, at last accounts.

**COPPER ZONE MINING CO.** **NEW MEXICO.**

Company was dispossessed of its lands and is probably dead.

**SOCIEDAD MINERA COQUIMBANA.** **CHILE.**

Property of this company, including the Rosario, Socavon and other mines, is located at La Serena, Coquimbo, Chile. Cannot be learned that company is producing at present.

**CORA-ROCK ISLAND MINING CO.** **MONTANA.**

Owns the Cora and Rock Island mines at Butte, Silver Bow Co., Mont.; 95% of stock issue is held by the United Copper Company.

**CORDOBA EXPLORATION CO., LTD.** **SPAIN.**

Offices: Hebburn-on-Tyne, England. Mine office: Manriques 9, Cordoba, Spain. Organized 1897, with capitalization £60,000, in £10 shares; debentures, about £50,000. Sir Andrew Noble, Bart., K. C. B., F. R. S., chairman; W. M. Brown, secretary; Richard E. Carr, vice-consul at Cordoba, general manager; Percy E. O. Carr, mining captain. Lands, 284 hectares, 701 acres, 10 miles northeast of Cordoba, Andalusia, Spain. Property is known as the Cerro Muriano group and was worked to a depth of at least

400′ by the Romans, notwithstanding the mines being very wet. Property shows 5 principal veins and several smaller fissure veins, carrying chalcopyrite with gangue of calcite, quartz, clay and country rock. Veins have following length: Calavera, 545 yards; Lorenzo, 1,525 yards; Excelsior, 545 yards; Cerro Muriano, 2,835 yards; Isabel, 1,850 yards; total, 7,300 yards. Some of the ore from the old Roman mines has assayed 28% to 34% copper. Company has unwatered old mines on the Cerro Muriano vein, pumping therefrom 3,000 cubic mteres of water daily. How the Romans handled such an inflow of water without machinery is a mystery. Main shafts, 300 metres apart, are 154 and 164 metres in depth. Vein was cut at depths of 100 metres, 130 metres and 160 metres, showing average width 5 to 13 metres. Best portions have been worked out by the Romans. This property is one of the largest and most interesting of the old Hispano-Roman mines, and was famous before the Christian era for the high quality of the copper and brass produced from its ores, but has been entirely idle for some 2,000 years, until reopened by the present owners.

**CORNELIA COPPER CO. ARIZONA.**

At Gila Bend, Pima Co., Ariz. C. G. Berryman, superintendent. Was developing with small force at last accounts.

**CORNELL MINE. BRITISH COLUMBIA.**

Located in Nanaimo district, B. C. Has three levels open, deepest 260′, on a 12′ vein, giving medium grade of chalcopyrite and a little bornite, in a felsitic gangue.

**CORNETT MINE. CALIFORNIA.**

Owned by H. W. Cornett, Merced, Mariposa Co., Cal. Vein matter is schistose diabase with 3′ pay-streak. Ore mainly chalcopyrite, running 17% to 23% copper and $2.25 to $4.50 gold per ton. Was developing with small force at last accounts.

**CORNUCOPIA COPPER CO. OREGON.**

Supposed to be developing property near Quartzburg, Baker Co., Ore., but no returns secured.

**CORNWALL COPPER MINES. MISSOURI.**

Located in Ste. Genevieve county, Missouri, and were worked on a fair scale circa 1860. The ores of copper are greater in variety than in quantity, those found including cuprite, covellite, malachite, azurite, chalcocite, bornite, chalcopyrite, melaconite, chalcanthite and chrysocolla.

**LA COMPANIA CORO CORO DE BOLIVIA. BOLIVIA.**

Mines, at Coro Coro, La Paz, Bolivia. This company works native copper occurring in beds of conglomerate, and is the largest producer of the district, making about 1,500 tons of mineral averaging 85% fine copper yearly. A little cuprite and chalcocite occur also; silver, found with the copper in native form, as at the Lake Superior mines, is an important by-product.

**CORONA GOLD & COPPER CO. NEW MEXICO.**

Has claims near Santa Rita, N. M. Reorganized 1902, with O. H. Baum as president. No returns secured.

**CORONADO MINING CO.** **ARIZONA.**

Office: 10 Postoffice Sq., Boston, Mass. Mine office: Clifton, Graham Co., Ariz. Employs 20 men. Organized 1902, under laws of Maine, with capitalization $3,000,000, shares $10 par. Wm. B. Thompson, president; John W. Belches, vice-president; W. J. Palmer, secretary; John K. Erskine, Jr., treasurer. Lands, 22 claims, in process of patenting, area 300 acres, showing several fissure veins and lenses carrying sulphide ores. Has several shallow shafts and tunnels, longest 200′. A considerable body of sulphide ore, assaying above 10% copper, has been opened on the Emerald claim, from which shipments were made to smelter at Cilfton, Graham Co., in 1902. The famous Coronado vein, long worked by the Arizona Copper Co., is supposed to run through this property, and will be searched for and developed. Property adjoins the mines of the Detroit and Arizona mining companies and is regarded as decidedly promising.

**CORUNA COPPER CO., LTD.** **SPAIN.**

Offices: Chiswell House, Finsbury Pavement, London, E. C., Eng. R. F. A. Malabar, secretary. Capital, nominal, £1,000,000. Company was organized to acquire the Santiago mines in the Province of Coruna, Spain.

**CORY BROS. MINING CO.** **MONTANA.**

Was developing a group of copper and gold properties on Beaver Creek, north of Helena, Montana, at last accounts.

**COXHEATH MINE.** **NOVA SCOTIA.**

Owned by Cape Breton Copper Co., Ltd.

**CRACKER JACK MINE.** **ARIZONA.**

Near Payson, Gila Co., Ariz. A. Lockwood, owner. Was prospecting with small force at last accounts.

**CREEDE COPPER MINING CO.** **WYOMING.**

Near Rawlins, Carbon Co., Wyo. L. E. Armstrong, secretary. Was working small force at close of 1902.

**CRESCENT COPPER CO.** **UTAH.**

Supposed to be operating near Park City, Summit Co., Utah, but no returns secured.

**CRESCENT COPPER CO.** **WYOMING.**

Office and mine: Encampment, Carbon Co., Wyo. G. E. Heber, superintendent. Was employing a few men on development work late in 1902.

**CRONA COPPER CO.** **COLORADO.**

Organized by C. W. Strong, secretary and treasurer, Lyons, Colorado; no returns secured.

**CRONNEBANE MINE.** **IRELAND.**

This property, near Wicklow, Ireland, was making about 1,250,000 pounds of refined copper annually, at the close of the Eighteenth century, but is now turning out only fifteen to twenty tons yearly, secured as cement copper from the mine-water leachings.

**CROWN LYELL, LTD.** **TASMANIA.**

Offices: 45, Renfield St., Glasgow, Scotland. J. B Sutherland, secretary.

Capital, nominal, £300,000; issued, £155,0C7. Property consists of mining claims at Mount Lyell, Montague Co., Tasmania.

**COMPANIA DE LA CRUZ. MEXICO.**

Mine office: La Cruz, Tamaulipas, Mexico. Opened by shafts; produces copper and lead; employs 200 men. J. M. Gonzales, manager.

**CRYSTAL LAKE GOLD & COPPER MINING & SMELTING CO. COLORADO.**

Office: Barristers' Hall, Pemberton Sq., Boston, Mass. Philip G. Dawson, president; Kendric P. Crawford, treasurer and general manager; A. D. Wise, secretary. Capitalization $1,500,000, shares $1 par. Has 4 claims on Hotchkiss Mountain, south of Lake City, Hinsdale Co., Colo., also other claims in vicinity of Lake City; no returns secured.

**CRYSTAL MOUNTAIN MINING & DRAINAGE CO. COLORADO.**

At Crystal, Gunnison Co., Colo. Geo. W. Melton, superintendent. Has copper, gold and silver ores, opened by tunnel, with steam power; small force employed.

**CUBA MINING CO. UTAH.**

At Bingham Canyon, Salt Lake Co., Utah. John Swanson, superintendent; copper-gold ores; steam power; employed 15 men at last accounts.

**CUBAN MINING & DEVELOPMENT CO. CUBA.**

Offices: Dashood House, London, E. C., Eng. Registered March 18, 1902. Capital, nominal, £250,000. J. J. Jonas, chairman; A. Mitchell, secretary; F. J. Rich, mine manager. Lands, 2,766 acres, in the province of Pinar del Rio, Cuba, carrying copper ores, with indications of asphalt and petroleum. Veins exposed range 6′ to 22′ wide and assay 5% to 16% copper. At last accounts Mr. Rich was reopening the Kohly mine, having 5 old shafts which were found in bad condition.

**CUBANA CONSOLIDATED COPPER CO. MEXICO.**

Supposed to own 545 acres, bought for $20,000, in the Arizpe district of Sonora, Mexico, but address of company not found.

**LA CUIVRE GROUP. BRITISH COLUMBIA.**

Owned by E. A. Cleveland, of Vancouver, B. C. Located on Princess Royal Island, Skeena river division, Cassiar district, B. C. Development limited to tunneling.

**CULLIGAN MINE. WISCONSIN.**

A property in Douglas Co., Wis., on which a little work was done in 1899; now idle.

**CUPRITE COPPER CO. ARIZONA.**

Mine office: Vail, Pima Co., Ariz. W. H. Lake, superintendent. Was developing by shaft and tunnels at last accounts.

**CUPRITE MINING CO. WYOMING.**

Property is in the vicinity of Holmes, Wyo. Was developing with small force at last accounts.

**CYPRESS MINE. ARIZONA.**

Near Bigbug, Yavapai Co., Ariz. Frank Thornton, superintendent. Said to have a good showing of copper-gold-silver ores.

**DALANE SOELV-OG-KOBBERGRUBER. NORWAY.**

A small producer of silver and copper, irregularly worked, at Brunkeberg Sogn, Norway.

**DALTON & LARK MINING & MILLING CO. UTAH.**

Absorbed by Bingham Consolidated Mining & Smelting Co.

**DALY MINE. MONTANA.**

At Copperopolis, Meagher Co., Mont. W. W. McDowell, lessee and manager. Property has been a small producer of exceptionally high-grade ore for some years past.

**DALY-JUDGE MINING CO. UTAH.**

Office: Salt Lake City, Utah. Mine office: Park City, Summit Co., Utah. Organized 1901, under laws of Utah, and understood to have cash surplus of about $150,000, and to be likely to pay dividends during 1903. John Daly, president; John J. Broughall, general manager; John McSorley, superintendent. Holdings very extensive, main tract including 265 acres patented lands; also owns Anchor mine, with 26 patented claims, area 450 acres, bought April, 1902, for one-fourth of the capital stock of the Daly-Judge Co. Has openings on 3 ore bodies, known as the South, Contact and North veins, the middle, or Contact vein, being the principal producer. Ore bodies are large, well defined and persistent, having been traced 3,000′. Main shaft, 1,650′, has 3 compartments and powerful hoist operating double-deck cages. Mine has upwards of 7 miles of underground openings, and is driving an 8,000′ drainage tunnel. Mill was greatly enlarged during 1902. Water is secured from a lake 2 miles from the mine. Property has excellent equipment and management and is very highly regarded in Utah.

**DALY-WEST MINING CO. UTAH.**

Office: 161 So. Main St., Salt Lake City, Utah. Mine office: Park City, Summit Co., Utah. Employs 500 men. Organized 1902, under laws of Colorado, with capitalization $3,600,000, shares $20 par. Dividends to close of 1902 have been $2,259,000. J. E. Bamberger, president and general manager; J. D. Wood, vice-president; J. Barnett, secretary; W. S. McCornick, superintendent; F. W. Sherman, mill superintendent. Lands, about 60 patented claims, area 250 acres, in the Uintah district of Summit Co. For 11 months ending Dec. 1, 1902, mine produced 57,000 gross tons of ore, which yielded 11,700 tons lead, 422 tons copper, 2,975,000 oz. silver and 6,211 oz. gold. Company is in strong financial position, and is an exceptionally prosperous and promising property.

**DAMARALAND COPPER SYNDICATE, LTD. GERMAN SOUTHWEST AFRICA.**

Office supposed to be at Johannesburg, Transvaal Colony, S. A. Is developing the Matchless mine, at Windhoek, German Southwest Africa. C. S. Herzig, manager.

**DANES LEA MINING CO. CALIFORNIA.**

Eight miles east of Encinitas, San Diego Co., Cal., near the Pacific coast. W. C. Harland, San Diego, Cal., president; W. H. McKinnon, Encinitas, Cal., manager. Lands, 20 claims, with 2 shafts of 100′ and 280′, also tunnel, in a 3′ vein of medium-grade chalcopyrite, traversing porphyry. Has gasoline power and company contemplates erecting concentrator.

**DAULTON COPPER CO.** **CALIFORNIA.**

Supposed to have property near Daulton, Madera Co., Cal.; no returns secured.

**DAVENPORT MINE.** **WASHINGTON.**

A prospect near the head of Horseshoe Basin, Wash. A ton of ore shipped to smelter gave returns of $69 in lead, copper, silver and gold.

**DAVID HARUM COPPER CO.**

Office: 30 Broad St., New York. Location of property, if any, unknown.

**DAVIS MINING & SMELTING CO.** **CALIFORNIA.**

Mine office: Oro Grande, San Bernardino Co., Cal. Lands, 3 copper and 9 gold claims. Has 80-ton water-jacket furnace, installed 1902. Dr. J. Doan Carey, secretary, Los Angeles, Cal.

**DE LAMAR-WALL MINING & MILLING CO.** **UTAH.**

Near Bingham Canyon, Salt Lake Co., Utah. G. B. Hazelgrove, superintendent. Has auriferous and argentiferous copper ores, developed by tunnel, with steam power; employs about 20 men.

**DECATUR COPPER MINING CO.** **ARIZONA.**

Office: 503 North Main St., Decatur, Ill. Mine office: Jerome, Yavapai Co., Ariz. Employs 10 men. Organized 1897, under laws of Arizona, with capitalization $2,000,000, shares $1 par. W. J. Wayne, president; Frank P. Wells, vice-president and treasurer; Geo. R. Bacon, secretary. Preceding officers, Eugene Head, C. W. Devore, W. S. Owens and Samuel Morthland, directors; W. S. Owens, superintendent. Lands, 10 claims, 4 patented, area 180 acres, also 10-acre millsite, 10-acre smelter site and sundry other lands, in the Verde district of Yavapai Co., showing 10 fissure veins and lenses, of which 4 are being developed, these having average width of 4′, giving average assays of 5% to 8% copper, $10 gold and 20 oz. silver per ton. Oxide and carbonate ores near surface; sulphide ores below depth of 50′ to 60′; 6 shafts, deepest, 280′; 2 tunnels of 70′ and 150′. Gasoline power. Property adjoins the United Verde mine. Fer 1903 company will drift, to develop 2 large ore bodies; will install new machinery and erect 10-stamp mill on gold mine in the Mineral Point district, where a free milling gold vein has been developed. Property seems conservatively managed and officers are men of good standing.

**DEDHAM COPPER MINING CO.** **WISCONSIN.**

Office: West Superior, Wis. A. B. Ross, president. Lands, 320 acres, 8 miles from West Superior, Douglas Co., Wis., on the northern fold of the Keweenawan copper formation. Has 11 testpits, along line of strike of a copper-bearing amygdaloid, in distance of 850′. Company has authorized bond issue of $150,000. Management of company composed of men of excellent standing.

**DEEP RIVER GOLD MINING CO.** **NORTH CAROLINA.**

At High Point, Guilford Co., N. C. W. G. Gaither, manager. Company is reopening old copper and gold mines.

**DEER CREEK GOLD & COPPER MINING CO. WASHINGTON.**

Near Silverton, Wash. Some development work done by tunnels and drifts, showing a considerable body of low-grade ore.

**DEL NORTE COPPER CO. CALIFORNIA.**

Supposed to be operating near Smith River, Cal., but no details secured.

**DELAWARE MINE. MICHIGAN.**

An idle property in Keweenaw county, Michigan, on which about $3,300,000 have been sunk by successive managements. Very fully described in the 1902 edition of this work.

**LA DEMOCRATA MINING CO. MEXICO.**

Operating at La Cananea, Sonora, Mexico. Has steam power and a small smelter, producing copper, gold and silver. Lands adjoin properties of Greene Consolidated.

**DENVER MINE. ARIZONA.**

At Gilbert, Yavapai Co., Ariz. John Witherally, owner and manager. Was developing gold-copper ores by shafts, at last accounts.

**DENVER COPPER MINING & LEASING CO. COLORADO.**

Had copper claims in the Morrison district, Colo. Letters to company, addressed Denver, returned unclaimed.

**DENVER GROUP GOLD & COPPER CO. ARIZONA.**

Office: 319 Douglass Bldg., Los Angeles, Cal. Mine office; Wickenburg, Maricopa Co., Ariz. Capitalization $2,000,000, shares $1 par. Thos. S. Wadsworth, president. Lands, 10 patented claims, area 194 acres, 12 miles northeast of Wickenburg. Mineral formation traced 6,000′, with width 80′ to 300′ of vein matter, showing scattered parallel veins and stringers. Has tunnels of 225′ and 600′, also 5 prospecting shafts. Assays show 15% copper and $10 gold per ton. Ore sulphide, carrying a little native copper.

**DERBY SYNDICATE, LTD. AUSTRALIA.**

Offices: 66, Finsbury Pavement, London, E. C., Eng. J. McLaren, secretary. Company supposed to be interested in copper property in Western Australia.

**DEROFFSKI MINE. SIBERIA.**

Near Semipalatinsk, Siberia; is a very small producer.

**COMPANIA MINERA FUNDADORA DESCUBRIDORA. MEXICO.**

This company is operating on a considerable scale in the states of Durango and Sinaloa. D. Gough, manager. At Mapimi, Durango, has a reduction plant and was enlarging smelters, in 1902. Has recently installed an electric plant. At Conejos, Sinaloa, company has mines and a 200-ton smelter, and is to have a branch railroad, 36 miles, from Conejos to Pelayo. Ore bodies said to be of great extent and value, and property is regarded as one of exceptional promise.

**DESCUBRIDORA MINING & SMELTING CO. MEXICO.**

See Compania Minera Fundadora Descubridora.

**DETROIT COPPER MINING CO. OF ARIZONA. ARIZONA.**

Office: 99 John St., New York. Mine office: Morenci, Graham Co., Ariz. Mines active, employing about 1,000 men. Production, 500 to 700 tons of ore daily. Output of refined copper for 1901 was 17,535,000 pounds. Estimated production for 1902, is 19,000,000 pounds. Organized under laws of Michigan, with capitalization $1,000,000, shares $25 par. Jas. Douglas, president; Jos. Van Vleck, vice-president; Geo. Notman, secretary and treasurer; Chas. E. Mills, superintendent; G. E. Hunt, mill superintendent. Principal mines of the company are the Ryerson, Arizona Central, Copper Mountain, Montezuma and Yankee. Company also worked a small force at the Superior mine, near Lordsburg, in the Virginia district, late in 1902, with a view to securing a silicious ore for fluxing, there being a lack of this grade of ore in the mines of the Clifton district. Concentrator and smelter are at Morenci, near the mines. Concentrator was partly rebuilt in 1902 and new machinery added. Only 400 gallons of water are used in concentrating one ton of ore. Old smelter was burned , June, 1900, and was replaced with a large and thoroughly modern plant of about 1,000 tons daily capacity, in 1901. Smelter turns out 99% blister copper. Ore is low grade, running 3% to 4% copper and carrying only traces of gold and silver, but ore measures are very extensive. Property is managed with commendable skill and economy. Fully equipped with steam, water and electric power.

**DEWEY CONSOLIDATED COPPER & GOLD MINING & MILLING CO. IDAHO.**

Had gold-silver-copper claims, at Grangeville, Idaho Co., Idaho, and had office at 215 Atlas Blk., Salt Lake City, Utah. Postal authorities unable to deliver letter to the company in November, 1902.

**DEWEY MINING CO. IDAHO.**

Was opening gold-copper claims by tunnels at Bear, Washington Co., Idaho. Letter to company returned unclaimed, November, 1902.

**DEWEY CITY MINING CO. COLORADO.**

Was operating, circa 1899, near Gunnison, Gunnison Co., Colo. No returns secured and company probably out of business.

**DIAMOND JOE MINE. ARKANSAS.**

Located at Silver City, Montgomery Co., Arkansas; Frank Pease, owner. Has a shaft; veins carry silver, lead and copper ores.

**EL DIAZ GOLD & COPPER CO. MEXICO.**

Office: 332 Drexel Bldg., Philadelphia, Pa. Mine office: Papinto, Jalisco, Mex. Organized 1901, under New Jersey laws, with capitalization $1,600,000, shares $1 par. Daniel Lamont, Jr., president and trustee; Aubrey F. Lee, secretary. Lands, 60 claims, including 12 old workings, in the Rancho de Papinto district of Jalisco. Property being reopened at last accounts. Equipment includes 25-ton gold chlorination mill and 40-ton gold amalgamation mill, also 40-ton smelter. Officers are men of good standing, No returns secured.

**LA DICHA MINING & SMELTING CO. OF MEXICO. MEXICO.**

See Mitchell Mining Co.

**DICKERSON MINING CO. MONTANA.**

At Basin, Jefferson Co., Mont. J. W. Dickerson, manager. Was developing gold-silver-copper ores with small force, by tunnel, with steam and water power, at last accounts.

**DINGO COPPER MINING CO.** **AUSTRALIA.**

At Essington, Rockley district, New South Wales. Sold about 200 tons of high-grade hand-picked ore to the Lloyd Copper Company in 1901.

**DISEMBRIDA MINE.** **MEXICO.**

Exploring what is apparently a considerable body of copper ore, by diamond drills, near Mapimi, Durango, Mexico.

**DOANE MINE.** **WYOMING.**

Property near Battle, Carbon Co., Wyo.; no returns secured.

**DOANE-RAMBLER MINE.** **WYOMING.**

Property in the Encampment district of Carbon Co., Wyo. P. C. Armbruster, superintendent. Has a considerable body of very high grade ore in sight; was installing steam plant and other machinery at close of 1902.

**DOANE-VERDE MINING CO.** **WYOMING.**

Office: 18-99 Randolph St., Chicago, Ill. Mine, at Rambler, in Battle Lake district of Carbon County, Wyo. Operates summer seasons only. Organized 1902, under laws of Wyoming, with capitalization $1,500,000, shares $1 par, non-assessable. J. T. Clarke, president; Oliver S. Brown, vice-president; Edw. C. Eicher, secretary; H. T. Clarke, Jr., treasurer; Robert H. Young, manager. Property, 7 claims, area about 140 acres. Company contemplates extensive developemnt work on claims adjoining the Doane-Rambler group, on which there is reason to expect a continuance of the rich veins noted in the Doane-Rambler.

**DOGSKIN MINE.** **NEVADA.**

At Reno, Washoe Co., Nev. Wm. Webster, superintendent. Is opening copper-gold veins, by tunnel, with small force.

**DOLCOATH MINE, LTD.** **ENGLAND.**

Offices: 158, Leadenhall St., London, E. C., Eng. Mine office: Camborne, Cornwall, Eng. F. Harvey, chairman; F. W. Thomas, secretary; R. A. Thomas, mine manager. A large producer of tin and a small producer of copper from mines at Camborne. Deepest shaft is down nearly a half mile.

**DOLLY HYDE MINE.** **MARYLAND.**

Located in Frederick county, Maryland, and is the principal copper mine of this state, though never a large producer. Ores occur as malachite, bornite and chalcopyrite, in limestone country rock. Now idle.

**DOLORES COPPER MINING CO.** **MEXICO.**

Mine office: Matehuala, San Luis Potosi, Mexico. W. B. A. Dingwall, general manager; Luciano Mureno, superintendent. Opened by tunnels and equipped with steam power; employs about 300 men.

**DOMINGUEZ COPPER MINING CO.** **COLORADO.**

Has property in Dominguez Cañon, near Delta, Colo., and plans resumption of work in 1903.

**DOMINION COPPER CO., LTD.** **BRITISH COLUMBIA.**

Address: Greenwood, B. C. Mines at various points in the Yale and

Cariboo district. Has a smelter at Greenwood. Property produces both gold and copper. James Breen, general manager.

**DON CARLOS & EUREKA CONSOLIDATED CO.** **MEXICO.**

Office: Detroit, Mich. Lands, at Nombre de Dios, Durango, Mexico; mines include Don Carlos Anexa, Eureka and others, developed by shafts and equipped with steam power. Ores carry copper, silver and gold. F. Lee Norris, manager; employs about 200 men.

**DONA LOUISA COPPER & GOLD MINING CO.** **MEXICO.**

Office: 69 Wall St., New York. Mexican general office; 1A, San Francisco 7, City of Mexico, Mex. Mine office: Acuitzio, Michoacan, Mex. Employs about 40 men. Organized 1902, under laws of Delaware, with capitalization $1,500,000, shares $5 par, $2 paid in. Chas. M. Heath, president; Wm. A. Buckman, vice-president; Manuel L. Ward, secretary, David Buchanan, treasurer. Directors are preceding officers, Jos. B. Quin, Geo. W. Lockwood, Jas. Verdin and Geo. Buckman. A. J. Peyton, general manager; J. G. Collinson, superintendent; T. Richmond Crum, mining engineer; Miguel Gojon, mining captain. Lands, 45 patented pertenencias, area 111 acres, in the Morella district of Michoacan, showing 4 fissure veins, of which 2 are being developed, these averaging 3′ wide by 300′ long and giving estimated values of 9% to 63% copper, up to $32 gold and up to 120 oz. per ton silver, from oxide ores. Shaft, 60′; 2 tunnels, aggregating 158′. Horse power; nearest railroad station, Coapa, 24 miles, on Mexican National R. R. For 1903 company contemplates installing steam hoist and sinking double compartment shaft to a depth of 500′. Mine shipped 100 tons high grade ore in December and company contemplates paying dividends, early in 1903.

**DOROTHY MINE.** **VIRGINIA.**

Located north of Virgilina, Va. Was a shipper of sulphide ores in 1900; no later returns secured.

**DOS CABEZOS CONSOLIDATED MINES CO.** **ARIZONA.**

Near Dos Cabezos, Cochise Co., Ariz. C. W. Roberts, superintendent. Was developing copper vein by tunnel, with steam power and small force, at last accounts.

**DOUBLE STANDARD GROUP.** **ARIZONA.**

At Lochiel, Santa Cruz Co., Ariz. Frank Olsen, owner and manager. Property has copper, silver and lead ores. Is developing by shaft, with small force.

**DOUGLAS MINE.** **NEVADA.**

Near Yerington, Lyon Co., Nev. H. E. Miller, superintendent. Was sinking shaft and driving tunnel at last accounts.

**DOUGLAS MINING & MILLING CO.** **WYOMING.**

Mine office: Douglas, Carbon Co., Wyo. Lands, in the Douglas Creek district. O. G. Blaisdell, superintendent. Property adjoins the Rambler. Ore, cuprite, carrying good gold values. Was working small force, in tunnel, at close of 1902.

**DRAGOON COPPER CO.**

Office: 924 Columbus Ave., Boston, Mass. No particulars learned, and no trace found of company's mining property, which, judged from title, presumably is located in Dragoon Mountains, Cochise Co., Ariz.

**DRAGOON COPPER MINING & SMELTING CO.** **ARIZONA.**

Office and mine: Pearce, Cochise Co., Ariz. Employs 19 men. Organized 1902, under laws of Arizona, with capitalization $2,000,000, shares $1 par, non-assessable. C. M. Renaud, president; W. Arthur, Phipps vice-president; G. H. Mosher, secretary and treasurer; G. M. Henry, general manager; preceding officers, M. Fraser and T. H. Gracy, directors; Henry Beckmann, mining captain. Property, 20 claims, area about 400 acres, also 5-acre millsite, in the Turquoise district of Cochise Co. Company is developing a fissure vein, dimensions not stated, carrying estimated average value of 16% copper, 30% lead, a little gold and 15 oz. silver per ton. Ores, oxides and carbonates. Main shaft, 100' deep. Gasoline power; company contemplates sinking shaft 700' in 1903.

**DROGSET KOBBERVAERK.** **NORWAY.**

At Meldalen, Norway. Produced 2,718 tons cupriferous pyrites in 1900.

**DRUMMER'S DEVELOPMENT CO.** **WASHINGTON.**

Address: care of Thos. Maloney, Chelan, Wash. Has secured some development; management expects to ship ore in 1903.

**DUCHESS MINING, MILLING & SMELTING CO.** **WYOMING.**

Office: Cheyenne, Wyo. Mine office: Holmes, Wyo. Le Roy Grant, general manager. Was developing, with small force, at last accounts.

**DUCKTOWN COPPER MINES.** **GEORGIA.**

At Pierceville, Fannin Co., Ga. Opened by shafts and have steam power.

**DUCKTOWN SULPHUR, COPPER & IRON CO.** **TENNESSEE.**

Offices: Gresham House, London, E. C., Eng. Mine office: Isabella, Tenn. Capt. J. Le Geyt Daniell, chairman; C. J. Browning, secretary. Registered Feb. 16, 1891. Capital, nominal, £75,000. Dividends, paid more or less regularly 1895 to 1900. Operates the Mary and Calloway mines, at Isabella, Tenn. Gross profits in 1900 were £26,107. Produces sulphuric acid and copper, from chalcopyrite and iron pyrites. Mines opened before the Civil War. Annual production of copper, two to three million pounds.

**DUGWAY COPPER MINING CO.** **UTAH.**

Property in Deep Creek district, Utah. O. F. Peterson, general manager. Has shaft 100' deep, on 15' vein between limestone and porphyry. Ores assay 1% to 36% copper, up to 45% lead, $1.60 gold and 17 oz. silver per ton.

**LA DULCINEA MINE.** **CHILE.**

In the Copiapo district, Atacama, Chile. Deepest shaft, one-half mile. Ores, oxide and carbonate to depth of 600', sulphides below. Vein, 25' wide in places; ore carries 5% to 25% copper.

**DULUTH COPPER CO.** **SOUTH DAKOTA & ONTARIO.**

Not found by postal authorities at Duluth, Minn. Company has copper prospects in Trill township, Algoma, Ont., also near Custer City, So. Dak. Was prospecting the South Dakota property with diamond drill at last accounts.

**DULUTH & ARIZONA COPPER MINING CO.** **ARIZONA.**

Office: 219 West Superior St., Duluth, Minn. Mine office: Prescott, Yavapai Co., Ariz. Capitalization $1,000,000, shares $1 par. Chas. W. Ericson, president; Wm. H. Daniels, vice-president; Wm. A. Hunt, treasurer; Gideon Schelin, secretary. Directors are preceding officers, Daniel G. Cash and Henry S. Swift. Lands, 4 claims, south of Prescott. Ores show average assay values of 11% copper and $6 gold per ton.

**DUMP MINE.** **COLORADO.**

At Black Hawk, Gilpin Co., Colo. Walter Lampshire, superintendent. Has shaft and steam power; ores carry gold, silver and copper; small force employed.

**DUNCAN GROUP.** **CALIFORNIA.**

Address: care of W. C. Duncan, Oroville, Cal. Property at Flournoys, Plumas Co., Cal. Reported values in Copper King shaft are 9% copper and $6 gold per ton. Development work in progress.

**DUNCAN MINING & DEVELOPMENT CO., LTD.** **BRITISH COLUMBIA.**

Lands: four claims in Cowhican Lake district, Victoria division, B. C. Several hundred feet of development work done in 1901. Ores assay 4% copper and 50% lead, with gold and silver values.

**DUQUESNE MINING & REDUCTION CO.** **ARIZONA.**

Near Washington, Santa Cruz Co., Ariz. J. B. Tener, agent. Was developing a copper ore body by shaft, with steam power and fair force, at last accounts.

**LA DURA MINING CO.** **MEXICO.**

Address: care of Hartmann & Groff, Torres, Sonora, Mexico. A gold-silver mine, with copper as by-product. Opened by shafts; steam power; 250 men employed.

**DURGEE MINE.** **VIRGINIA.**

In Virgilina district, Va. Area, 1,500 acres; three shafts, deepest 175′; vein averages 7′ wide and assays 4% to 20% copper.

**DUTCH MILLER MINING & SMELTING CO.** **WASHINGTON.**

Office: 202 Denny Way, Seattle, Wash. Mine office: Skyhomish, King Co., Wash. H. P. Fogh, superintendent. Lands show vein with maximum width of 18′, carrying auriferous chalcopyrite, from which returns of several small shipments averaged $37.65 per ton, net. Has shaft, tunnel and open-cut. Company has expended about $15,000 on the property, which is said to have a fair showing of ore.

**DZANSULSKI WORKS.** **RUSSIA.**

Mines at Tiflis, Kutais, Russia. T. L. Lazarev, owner. Produced 14,000 poods fine copper in 1899.

**EAGLE COPPER CO.** **WYOMING.**

Office and mines: Battle, Carbon Co., Wyo. Sherman Ludwig, superintendent. Was doing development work, with small force, at last accounts.

**EAGLE COPPER & GOLD MINING CO.** **IDAHO.**

Office: Wallace, Idaho. Organized October, 1902, under laws of Idaho, with capitalization $1,000,000, shares $1 par. Incorporated by J. H. Nordquist, Alex. B. Livingston, et al. Property, short distance southeast of Mullan, Idaho, has been undergoing development for several years.

**EAGLE COPPER MINING CO.** **WASHINGTON.**

Mine office: Chewelah, Stevens Co., Wash. M. Mitchell, superintendent. Lands, 3 claims, south of the Wonderful Group, on Stevens Peak. Assays show gold, silver, lead and copper. Developing by shaft and tunnel, at last accounts.

**EAGLE MINING CO.** **CALIFORNIA.**

At Needles, San Bernardino Co., Cal. H. Ahrens, superintendent. Is developing copper prospects by shaft.

**EAGLE & BLUE BELL MINES.** **UTAH.**

A gold property at Tintic, Utah, carrying considerable values in copper.

**EASTER SUNDAY MINING CO.** **ARIZONA.**

At Bisbee, Cochise Co., Ariz. A. M. Tong & Co., lessees. Was working about 20 men at last accounts.

**EASTERN NATIONAL COPPER CO., LTD.** **NOVA SCOTIA.**

Office: 16 Prince St., Halifax, N. S. Mine office: Cheticamp, Inverness Co., N. S. Employs 20 men. Organized 1902, under laws of Nova Scotia, with capitalization $500,000, shares $10 par, non-assessable. Jas. Reeves, president; Robert J. Leslie, vice-president; John W. Regan, secretary and treasurer; Wm. R. Dunn, general manager; preceding officers, Thos. J. Locke, John Strachan, Jas. Reardon and Fred P. Ronnan directors; Milton V. Grandin, superintendent and engineer. Property, about 149 acres, crown-granted under 80-year lease, also mill and smelter site and 200 acres other lands. Three lenticular ore bodies are being developed, these averaging 14′ width and apparently semi-continuous for about a mile. Estimated value, 5% copper, $10 gold and 5 oz. silver per ton. Ores, exclusively sulphide. Test shaft now sinking, at depth of 200′. Drift will be driven 1,000′. Permanent machinery outfit under consideration. Property is 6 miles from Inverness railway. New work contemplated for 1903 includes extensive underground development and utilization of water power owned by company, Plans for milling and smelting not perfected. Company will have a large and capacious harbor, 7 miles from the mine, also good railroad facilities.

**EASTERN STAR MINE.** **ARIZONA.**

At Williams, Coconino Co., Ariz. Owned by Davis & Fleming; J. L. Davis, superintendent. Has gasoline power and small force.

**J. M. ECHAVARRIA.** **CHILE.**

Operates the Quilomenco mine, opened 1892, in the department of Illapel, Chile. Production, about 100 tons of refined copper yearly.

**EDNA MAY MINING CO.** **COLORADO.**

At Winfield, Chaffee Co., Colo. Henry Munroe, superintendent. Is developing gold, silver and copper ores, by tunnel; employs 10 men.

**EDDY GOLD, SILVER & COPPER MINING CO.** **ARIZONA.**

Office: probably Phœnix, Ariz. Property is Copper Butte and adjoining claims, in Maricopa County, Arizona.

**EINASLEIGH FREEHOLD COPPER MINES, LTD. AUSTRALIA.**

Offices: Hamilton House, Bishopsgate St. Without, London, E. C., Eng. J. S. Smith, chairman; W. H. Woodhead, managing director at mines; T. Mullett, secretary. Local office: A. M. P. Chambers, Edwards St., Brisbane, Queensland. Capital, nominal, £200,000. Property, 120 acres freehold, at junction of Einasleigh and Copperfield rivers, Gilbert Co., Queensland, also 20 acres iron ore lands, for fluxes, near mines. Main shaft, 190′. Property greatly handicapped by distance, 110 miles, from railroad. Good ore bodies shown by development. Has a 32x75″ water-jacket blast furnace, which is not in operation at present. Product for 1901 was 104 long tons copper and 1,330 oz. silver, from 1,009 tons of ore; employs about 75 men in development work.

**EINASLEIGH SOUTH BLOCKS. AUSTRALIA.**

Owns mineral lands south of Einasleigh Freehold mine, in Queensland. Was sinking exploring shaft in 1901.

**EISENMANN Y CARDENAS. MEXICO.**

Operating in the Huacana district, Ario, Michoacan, Mexico.

**EL CAPITAN COPPER CO. ARIZONA.**

Office: 66 Broadway, New York. Organized 1901, under laws of Arizona, with capitalization $1,000,000. Jas. D. Taitt, president; Jas. H. Plummer, vice-president; Chas. H. Landers, secretary; C. H. H. German, treasurer. Annual meeting third Tuesday in January. Property, in Yavapai Co., Arizona. No returns secured.

**EL CARMEN COPPER CO.**

Office: somewhere in New York City. Location of property unknown.

**EL DORADO COPPER MINING CO. COLORADO.**

Office: Denver, Colo. Organized November, 1902, by Calvin Esterly, et al, to operate in Colorado.

**EL REY GOLD & COPPER MINING CO. WYOMING.**

Office and lands: Encampment, Carbon Co., Wyo. W. C. Henry, general manager. Supposed to be developing with small force.

**ELIZABETH MINING CO. VERMONT.**

Office: South Strafford, Orange Co., Vt. Wm. Glen, president; Jas. W. Tyson, Jr., secretary. Has large ore body, carrying 3% to 6% copper. No returns secured from company; property thought to be in hands of Geo. Westinghouse, Pittsburg, Pa.

**ELK MOUNTAIN MINING & MILLING CO. WYOMING.**

Office and mines: Encampment, Carbon Co., Wyo. R. O. Kaylor, vice-president; S. E. Phelps, secretary; B. A. Kaylor, superintendent. Has vein with pay streak of 4″ to 2′ chalcocite, averaging returns of 33% in smelter, with some gold and silver values.

**ELLA COPPER MINING & DEVELOPMENT CO. CALIFORNIA.**

Office: San Jose, Cal. Property, near the New Almaden cinnabar mine, is said to have 40′ vein of 10% copper ore.

**ELM RIVER COPPER CO. MICHIGAN.**

Office: 60 State St., Boston, Mass. Mine office: Winona, Houghton

Co., Mich. Organized Apr. 20, 1899, under laws of New Jersey, with capitalization $2,500,000, in 100,000 shares, par $25 and $12 paid in. Annual meeting, third Wednesday in April, at Jersey City, N. J. H. F. Fay, president; W. B. Mosman, secretary and treasurer; James Chynoweth, superintendent. Property, 2,360 acres, in Section 6, Town 52 North, Range 35 West, and in sections 1, 2, 11 and 12, Town 52 North, Range 36 West. Explorations have been conducted by shafts and diamond drill. Fully described in last annual edition.

**ELSIE MINING CO.** **COLORADO.**

At Winfield, Chaffee Co., Colo. L. J. Reed, superintendent; was developing gold, silver and copper ores by tunnel at last accounts.

**ELY MINE.** **VERMONT.**

See Copperfield.

**EMERALD MINING & SMELTING CO.** **MEXICO.**

Office and mines: Santa Catarina, Baja California, Mexico. W. R. Ramsdell, superintendent. Is operating La Esmeralda copper mine, opened by shafts, and employs about 75 men.

**EMMA MINE.** **MONTANA.**

Owned by Butte Mining & Development Co.

**EMMONS MINE.** **NORTH CAROLINA.**

At Lexington, Davidson Co., N. C. Opened before Civil War; reopened after war; again worked, circa 1891, by a Baltimore company. Has two shafts, 680′ apart, deepest 460′; vein, 3′ to 8′, carrying chalcopyrite.

**EMPIRE MINE.** **ARIZONA.**

At Lochiel, Santa Cruz Co., Ariz. Stephen O'Connor, owner. Was developing copper, silver and lead ores by a shaft at last accounts.

**EMPIRE COPPER CO.** **NEVADA.**

Had offices at 20 Broad St., and also at 95 Liberty St., New York. Letters to these addresses returned from New York postoffice marked "Removed; present address unknown." Property was near Reno, in the Pyramid Lake district of Washoe Co., Nevada, comprising 26 claims. Company secured considerable development work and good assays, and had a 40-ton smelter. Is understood that practically all of the Empire Company's property has been turned over to the Pacific Consolidated Mining Co.

**EMPIRE MINES CO.** **NEW MEXICO.**

At Hanover, Donna Ana Co., N. M. J. W. Bible, superintendent. Has considerable development on a promising copper ore body. Opened by shafts, equipped with steam power and 100-ton concentrator; employed about 75 men at last accounts.

**EMPIRE MINING CO.** **MICHIGAN.**

Address: care of W. K. Prudden, Lansing, Mich. Idle. Owns 2,100 acres, near Mosquito Lake, Keweenaw Co., Mich. Reincorporated for term of 30 years in 1899.

**EMPIRE & STAR MINING, MILLING & SMELTING CO.** **WYOMING.**

Near Hecla, Laramie Co., Wyo. Henry S. Schwartz, superintendent.

Has gold-silver-copper ores, opened by shafts; is equipped with steam power; has 15 stamps and a leaching plant; employed about 25 men at last accounts.

**ENCAMPMENT MINING CO. WYOMING.**

Mine office: Encampment, Carbon, Co., Wyo. B. E. Burger, superintendent. Was working small force at last accounts.

**ENCENITAS COPPER MINES. CALIFORNIA.**

Supposed to be in the neighborhood of Encinitas, San Diego Co., Cal., but no returns secured.

**ENCINILLAS MINES, LTD. MEXICO.**

Offices: in London, England. Mine office: Santa Rosalia, Chihuahua, Mex. Paul Ginther, manager. Operates the Dolores mine, opened by shafts and tunnels, and produces gold, copper, silver and lead. Has 50-ton smelter and employs about 150 men.

**ENGLE COPPER MINING CO. CALIFORNIA.**

Mine office: Taylorville, Plumas Co., Cal. Was developing sulphide and carbonate ores by tunnels and open cut, in spring of 1902.

**ENGLISH & AUSTRALIAN COPPER CO., LTD. AUSTRALIA.**

Offices: 142, Palmerston Bldgs., London, E. C., Eng. Operates smelting works at Port Adelaide, South Australia, and at Newcastle, N. S. W.

**ERIE COPPER MINING CO. UTAH.**

Office: 4 Atlas Blk., Salt Lake City, Utah. Mine office; Milford, Beaver Co., Utah. Employs 14 men. Organized 1902, under laws of Utah, with capitalization $1,500,000, shares $1 par. C. E. Albrook, president; F. C. Morehouse, vice-president and superintendent; L. G. Brown, secretary and general manager; W. J. Murray, treasurer. Directors are preceding officers, J. D. Newcomer, Wm. Weldin, A. C. Ellis and J. S. Ferris. Lands, 15 unpatented claims, showing fissure veins carrying oxidized ores near surface, with sulphides noted at bottom of double-compartment shaft, 150′ deep at close of 1902, and sinking at rate of 2′ daily. Will continue development work and install steam hoist, air compressor and drills. Property has 2,000′ of the O. K. vein of the Majestic Co., giving assays of 3.5% copper and $3 to $8 gold and silver per ton.

**ERIEGA COPPER & COAL MINING & SMELTING CO. MONTANA.**

John F. Firch, Butte, Mont., president. Company makes strong claims, but does not state where its properties are located, although repeatedly requested to furnish particulars.

**ESCURIAL COPPER MINES, LTD. SPAIN.**

Offices: 3, Union Court, London, E. C., Eng. J. Taylor, chairman; C. Browne, secretary. Spanish office: Pelayo 2, Barcelona, Spain. Capital, nominal, £125,000. Lands, about 200 acres, include the Ramon, Jaime, Antigua Pilar and La Gloria mines. Is equipped with buildings and machinery. New smelter was completed in 1902.

**SOCIEDAD ESPANOLA DE FUNDICION. CHILE.**

Operates Los Anjeles mine, opened 1899, in the department of La Ligua, Chile. Product, shipped as matte, is equivalent to about 300 tons of copper yearly.

**ESPERANZA GROUP.** **SPAIN.**

About 8 miles west of the Rio Tinto, in the province of Huelva, Spain. Is being developed by an English corporation and will become a producer to the extent of probably 1,000 tons of fine copper annually, within two or three years.

**COMPANIA MINERA ESPERANZA Y CONSTANCIA.** **MEXICO.**

Office: Monterey, N. L., Mex. Mine office: Sierra Mojada, Coahuila, Mex. Miguel Bernardino, manager. Operates La Fortuna mine, opened by 350′ shaft, equipped with steam power and producing silver, lead and copper. Employs about 250 men.

**ESPIE BAY MINES DEVELOPMENT SYNDICATE, LTD.** **TURKEY.**

Offices: 34, Old Broad St., London, E. C., Eng. W. F. S. Armstrong, secretary. Capital, nominal, £30,000. Property, old copper mines on Espie Bay, near Tereboli, Turkey in Asia Minor. Mines reopened 1901, by this company; no returns secured.

**JOSE R. ESPINOZA.** **CHILE.**

Operates Las Palmas mine, opened 1880, making 100 to 150 tons copper yearly, also Cantarito mine, opened 1898, making 50 tons of copper annually, both in the department of Petorca, Chile.

**ESTERBROOKE MINING CO.** **WYOMING.**

Office: Douglas, Wyo. A. R. Kelly, manager. Was doing development work at last accounts.

**COMPAGNIE LA ESTRELLA.** **SPAIN.**

Office: Blvd. Haussman, 161, Paris, France. Is developing copper properties in the province of Almeria, Spain. No returns secured.

**NUEVA SOCIEDAD PROPRIETARIA LA ESTRELLA.** **SPAIN.**

Office: Granada, Spain. Is opening La Jerezana mine in the province of Granada, Spain.

**ETHEL CONSOLIDATED MINES CO.** **WASHINGTON.**

Office: 521 New York Blk., Seattle, Wash. Mine office: Index, Snohomish Co., Wash. Succeeded Ethel Copper Mining Co. and John D. Copper Co., also absorbed the Mother Lode group. Organized 1902, with capitalization 3,500,000 shares, par value unknown. G. A. Pounder, president and general manager. Lands, 37 contiguous claims, giving 21,000′ on line of vein. Principal development on the Ethel group, which has ore body averaging about 4% copper with a little gold and silver. Much higher assays obtained from selected samples. Power furnished by Pelton water wheel; has a saw mill; 100-ton concentrator, with crusher, rolls and Huntington mill, three-fourths mile from mine and connected therewith by a gravity tram with a 30° incline, equipped with automatic steel ore cars. Opened by tunnels; has nearly a quarter-mile of underground development. Ores, chalcopyrite, bornite, and chalcocite, mainly bornite at depth, in a quartz gangue, averaging 4% copper. Mine begun shipments in summer of 1902.

**ETHEL COPPER MINING CO.** **WASHINGTON.**

Succeeded by Ethel Consolidated Mines Co.

**ETNA MINING CO.** **COLORADO.**

At Georgetown, Clear Creek Co., Colo. W. D. Hoover, manager. Has gold, silver, lead and copper ores; opened by a tunnel.

**ETRUSCAN COPPER ESTATES, LTD.** **ITALY.**

Offices: 139, Queen Victoria St., London, E. C., Eng. Mine office: Campiglia, Tuscany, Italy. A. J. Walter, chairman; J. Pope, secretary. Capital, nominal, £575,000. Owns the Lanzie and Temporino estates, area 1,300 acres, held in freehold. Property shows ancient copper workings; is at present producing zinc and lead ores.

**EUREKA CLAIMS.** **VERMONT.**

Properties are the Eureka and Union, sometimes known as the Pike Hill mines. E. L. Smith, general manager. Fifteen men employed in development work, at last accounts.

**EUREKA COPPER CO.** **ARIZONA.**

Had an office at 48 Wall St., New York, but company cannot be found by New York postal authorities. Lands, about 8 miles west of Globe, Gila Co., Ariz., showing a considerable body of low-grade ore.

**EUREKA COPPER MINING CO.** **WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. Capitalization $2,000,000, shares $1 par. H. A. Frambach, president; W. C. Henry, vice-president; O. B. Thompson, secretary; Bernard McCaffrey, treasurer. Lands, 5 claims, area 103 acres, 3 miles southwest of Encampment. Shaft, 140′. No returns secured.

**EUREKA DEVELOPMENT CO.** **ARIZONA.**

Office: Calumet, Mich. Lands, near Tucson, Pima Co., Arizona. H. T. Allen, superintendent; no returns secured.

**EUREKA MINE.** **HONDURAS.**

In Orica Basin, department of Tegucigalpa, Honduras. Produces gold, silver and copper, latter in small quantities as a by-product.

**EUREKA MINING & MILLING CO.** **ARIZONA.**

Office: Tombstone, Ariz. Mine office: Naco, Cochise Co., Ariz. Lands, 7 claims, in the Huachuca Mountains, Cochise Co., near the Mexican line. O. B. Steen, president; E. P. Draper, vice-president; F. W. Goodbody, secretary; F. N. Wolcott, treasurer; E. A. Hockley, superintendent. Copper Glance group, opened by tunnels, has extensive underground development, has produced and shipped more than $100,000 worth of ore and concentrates, giving average smelter returns of about $150 per ton, averaging 27% copper, $6 gold and 184 oz. silver per ton. Eureka group has produced about $15,000 worth of ore. Company is managed by men of good standing, and property considered valuable.

**EUREKA MINING, SMELTING & POWER CO.** **WASHINGTON.**

Supposed to be planning to build a $65,000 smelter on Snake River, 45 miles south of Lewiston, Washington, near the Oregon and Idaho state line. Said to have a 10′ ore body.

**EUREKA HILL MINING CO.** **UTAH.**

Mine office: Eureka, Juab Co., Utah. Jos. Watson, superintendent. Has steam, water and electric power, with 100-stamp mill; employs about 150 men. Secures a little copper as a by-product from gold-silver ores.

**EUSTIS MINES.** **VIRGINIA.**

Located in Halifax Co., Virginia, and opened before the Civil War. A little ore has been shipped to Norfolk for smelting during the past two years.

**EVANGELINA COPPER MINING CO.** **MEXICO.**

Office: 204–202½ So. Broadway, Los Angeles, Cal. Mine office: Santa Catarina, Ensenada de Todas, Santos, Baja California, Mexico. D. R. Wilder, president; J. H. Coleman, vice-president; Josephine H. Wilder, secretary and treasurer; C. L. Ripperdan, superintendent. Lands, about 150 acres, show outcrops of 15% ore. Fissure vein opened, ranging from a few inches to 6′ wide.

**EVENING STAR MINING CO.** **WYOMING.**

Mine office: Riverside, Carbon Co., Wyo. T. R. Clemens, superintendent. Was developing, with small force, at last accounts.

**EVERETT MINE.** **NORTH CAROLINA.**

Presumably in the Virgilina district. Owners were installing machinery in 1902 and claim to have 560,000 tons of 6% ore blocked out.

**EVERGREEN BLUFF MINE.** **MICHIGAN.**

Lies south of Adventure and Mass mines, in Ontonagon county, Mich. Worked 1854–1863. Idle since 1863. Produced 675 tons, 1,174 lbs. refined copper at a cost of $223,582.24.

**EXCELSIOR COPPER CO.** **ARIZONA.**

Address: care of W. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Lands, near Pima, Pima Co., Ariz. This firm has promoted a considerable number of copper mining companies, the stock of all of which is worthless, so far as can be learned. The firm is in bad odor with investors, and has been charged repeatedly with fraudulent operations, and is in difficulty with the United States postal authorities for alleged misuse of the mails. Has been repeatedly requested by letter, and also asked personally, by the writer, in October, 1902, to furnish returns for this and other companies. The firm repeatedly promised to give these returns, but did not do so. The return blank for this edition of the Copper Handbook contained 73 questions, thoroughly covering all details of organization, officers, finances, developments, etc., and was required to be dated and signed in ink by some responsible officer of each corporation sending returns. As an intentionally fraudulent return would render the party making same liable to criminal prosecution, very few of the bogus copper mining companies, of which every country unfortunately has a considerable number, have dared to fill out and return the blanks.

**EXCELSIOR COPPER CO.** **QUEBEC.**

Mines at West Broughton, Megantic Co., Que. Ore bodies are opened by shaft and open cut; steam power.

**EXCELSIOR MINING CO.** **NEW MEXICO.**

At Organ, Donna Ana Co., N. M. Chas. W. Jewell, superintendent.

Was developing a copper ore body, with gasoline power and small force, at last accounts.

**EXCELSIOR MINING & SMELTING CO.** **NEVADA.**

Office: Butte, Mont. Mine office: Yerington, Lyon Co., Nev. Capitalization, $200,000. John F. Forbes, president; Frank E. Shaw, secretary. Has 150-ton water-jacket furnace, installed 1901, and is said to be smelting oxide and carbonate ores averaging 10% copper. Mine is developed by tunnels. Has steam and gasoline power; was working 100 or more men at last accounts. No returns secured.

**EXCHANGE GOLD & COPPER MINING CO.** **ARIZONA.**

Office: given as Nevada Blk., San Francisco, Cal., but company not found by postal authorities. Lands, supposed to be 20 claims, in vicinity of Flagstaff, Arizona.

**FAIRVIEW MINING CO.** **MONTANA.**

Mine office: Basin, Jefferson Co., Mont. Timothy Downey, superintendent. Gold, silver and copper ores; opened by shaft and tunnel; has steam power; employs about 20 men.

**COMPANIA MINERA FARELLON.** **CHILE.**

Owns copper properties at Puquios, Copiapo, Atacama, Chile.

**FARGO GOLD & COPPER MINING CO.** **IDAHO.**

Office: Fargo, N. D. Mine office: Imnaha, Idaho. H. M. Peterson, president; V. Landquist, vice-president; J. A. Husebye, secretary and treasurer. Said to have about $35,000 worth of ore on the dump at the mine. Was installing a reduction plant at the close of 1902. Company composed of solid men and said to have good prospects.

**FARREL COPPER CO.** **MONTANA.**

Absorbed by Pittsburg & Montana Copper Company.

**FAUQUIER COPPER CO.** **VIRGINIA.**

Is developing a copper property in Fauquier Co., Va. H. A. Palmer, superintendent. Has steam power; no returns secured.

**FAVORITE GOLD & COPPER MINING CO.** **WASHINGTON.**

Office: 201 Uihlein Bldg., Milwaukee, Wis. Lands on Mt. Ellemeham, Okanogan Co., Wash. A. M. Wehe, general manager. Has tunnel, 650′, on 4′ vein for entire distance.

**LA FE MINE.** **MEXICO.**

Mine office: Jimulco, Coahuila, Mex. Owned by Pearson & Randall; Geo. Pearson, manager. Mines copper, gold and silver ores; employs about 75 men.

**FEDERAL COPPER CO.** **MICHIGAN.**

Office: 207 First National Bank Bldg., Duluth, Minn. Organized 1902, under laws of Minnesota, with capitalization $600,000, shares $10 par. P. L. DeVoist, president; F. W. Heinrick, vice-president; F. D. Adams, secretary and treasurer; directors are preceding officers, A. C. LeDuc and A. M. Miller, Jr. Lands, 360 acres, are in Houghton Twp., Keweenaw Co., Mich., carrying 4 supposedly cupriferous amygdaloids. Property idle.

**FEDERAL COPPER CO.** **WYOMING.**

Office: Laramie, Wyo. J. B. McKee, secretary. Lands supposed to be in Carbon Co., Wyo. No returns secured.

**FEDERAL COPPER CO., LTD.** **WISCONSIN.**

Office: 214 Lumber Exchange Minneapolis, Minn. C. S. Dudley, president. Organized under laws of Arizona, with capitalization $2,500,000, shares $1 par. Lands, 1,120 acres, of which 520 acres are 6 miles southeast of Superior, Douglas Co., Wis., and 600 acres are in the St. Croix valley, Burnett Co., Wis.

**FEDERAL GOLD & COPPER CO.** **NEVADA.**

Office: 214 Lumber Exchange, Minneapolis, Minn. Mine office: Dayton, Lyon Co., Nev. C. S. Dudley, president. Supposed to own the Como-Eureka mine, near Dayton. Company is probably a reorganization of the Federal Copper Co., Ltd.

**FEDERAL MINING CO.** **ARIZONA.**

Office: 1112 Park Row Bldg., New York. Mine office: Safford, Graham Co., Ariz. Employs 30 men. Organized 1902, under laws of Delaware, with capitalization $1,000,000, shares $10 par. Francis H. Wilson, president; Louis Graner, vice-president; Frank S. Weller, secretary; Henry E. Hutchinson, treasurer; directors are preceding officers, F. H. Cowperthwait, Geo. V. Sheffield and Jas. Virdin. E. R. Stafford, general manager; I. L. Qualey, mining engineer; Richard Coleman, mining captain. Property, 24 claims, 18 patented, 6 unpatented, area 470 acres, in the Lone Star district of Graham Co., Ariz. Three fissure veins, average width 9′ and estimated average length 4,500 feet, are being developed. These show carbonates near surface and melaconite at 300′ to 400′ depth, with sulphides below. Estimated value, 14% copper, $5 to $20 gold and trace to 2 oz. silver per ton. Has 16 shallow prospecting shafts, of 15′ to 40′, 3 working shafts of 85′, 300′ and 400′, also 3 tunnels, 175′ to 300′. Has a considerable amount of good quality ore developed for stoping. Uses gasoline and steam power. Ore shipped by wagons to smelter at Safford, 8 miles from mine. Smelter equipment includes 50-ton water-jacket furnace, complete equipment costing $15,000. Product is turned out as 75% matte. New work contemplated for 1903 includes two additional 300′ tunnels and a 50-ton concentrator, to reduce the ore five into one. Company is a consolidation of the Gila Valley company and the Horseshoe company. About 80% of stock is held by the directors and 10% remains in the treasury. Messrs. Weller and Qualey are now under indictment for alleged fraudulent dealings with shareholders of the Horseshoe Co.; other officers of the Federal Mining Co. not implicated in these troubles.

**SOCIETE DELLA FENICE MASSETANA.** **ITALY.**

Mines at Massa Maritima, Grosseto, Italy. Mining is done mainly on a deposit of chalcopyrite running 2.25% to 12% copper. A little native metal is also found.

**FERRIS-HAGGERTY COPPER MINING CO.** **WYOMING.**

Absorbed, 1902, by North American Copper Mining Company.

**COMPANIA DE MINAS FERROCOBRIZAS.** **SPAIN.**

Office: San Isidro 16, Sevilla, Spain. Mine office: Cortegana, Huelva, Spain. No returns secured.

**FLINT STEEL MINE.** **MICHIGAN.**

A tract of 400 acres, near the Michigan mine, in Ontonagon county, Mich. Produced 415 tons, 458 lbs. refined copper, at a considerable loss. Idle since about 1875.

**LA FLORENCIA MINE.** **MEXICO.**

A property at Moctezuma, Sonora, Mexico, from which no direct returns have been secured.

**FOLLOWELL MINE.** **VIRGINIA.**

In Virgilina district, Virginia; owned by Boston parties, with smelter at West Norfolk, Va. Deepest shaft, 400′. Said to have produced a half million dollars worth of ore.

**FOND DU LAC MINE.** **WISCONSIN.**

Located in Douglas Co., Wis. Sunk two shafts, deepest 65′, in 1899; since idle.

**FORAN MINE.** **ARIZONA.**

At Stoddard, Yavapai Co., Ariz. Samuel Foran, owner. Opening a copper vein by shaft at last accounts.

**FOREST MINE.** **WASHINGTON.**

At Darrington, Snohomish Co., Wash. Thos. Parks, superintendent. Is developing a copper vein by tunnel.

**FOREST HILL CONSOLIDATED MINING & MILLING CO.** **COLORADO.**

Is developing a gold, silver, lead and copper property at Tincup, Gunnison Co., Colo. J. C. Jenson, superintendent. Has steam power, and employs 20 men.

**FORTUNA GROUP.** **CALIFORNIA.**

In Siskiyou Co., Cal. E. C. Harrison, owner, Callahan, Cal. Ore is chalcopyrite in gangue of pyrrhotite, traversing gabbro and diorite. Was developing by shaft at last accounts.

**COMPANIA MINERA LA FORTUNA.** **MEXICO.**

Mine office: Tepezala, Aguascalientes, Mex. Geo. B. Wardman, superintendent. Operates La Fortuna and adjoining mines, opened by shaft, producing copper and silver. Uses animal power; employs about 150 men.

**FORTUNA MINING CO.** **CALIFORNIA.**

Mine office: Fortuna, Trinity Co., Cal. C. Sweet, president. Has 19 unpatented claims, 5 miles from Humboldt county line, in Trinity Co., Cal. Development work under way.

**FORTUNA MINING & MILLING CO.** **UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. Elmer Hill, superintendent. Has copper-gold-silver-lead ores, developed by shaft and tunnel. Is equipped with steam and electric power and has a 50-ton concentrator; employed about 50 men at last accounts.

**FORTY-SEVEN MINE.** **WASHINGTON.**

At Index, Snohomish Co., Wash. H. McKinnon, owner. Has copper and silver ores; developing by tunnel at last accounts.

**FOUR BROTHERS COPPER MINE.** **WASHINGTON.**

At Silverton, Snohomish Co., Wash. Lands, 4 claims, carrying copper, gold and silver, with about 500′ of development work, mainly by tunnels.

**FOURTH OF JULY MINING & MILLING CO.** **COLORADO.**

Mine office: Eldora, Boulder Co., Colo. J. B. Johnson, superintendent. Developed by shafts and tunnels of 220′. Plans to cut the Olympic and Fourth of July veins, on which ore assays 25% to 45% copper, some lead, $30 to $60 gold and 50 to 125 oz. silver per ton. Employed 15 men at last accounts.

**DUNCAN FOX Y CA.** **CHILE.**

This firm owns a large number of copper claims at and near Cobija, Tocapella, Antofagasta, Chile. No direct returns secured.

**SOCIETE FRANCAISE MINIERE ET METALURGIQUE EN SERBIE.** **SERVIA.**

Offices: Rue de Courcelles, 147, Paris, France. Company is developing copper properties in Servia.

**SOCIETE FRANCAISE DES PYRITES DE HUELVA.** **SPAIN.**

Offices: Rue du Chateaudun, 39, Paris, France. Mine office: Valdelamusa, Huelva, Spain. Property includes the Perrunal mine, worked for both copper and sulphur.

**SOCIETE MINIERE ET METALURGIQUE FRANCO-ESPAGNOLE.** **SPAIN.**

Offices: Rue de Lisbonne, 8 bis, Paris, France. Company supposed to be interested in Spanish pyritic mines, but location of property and other details not secured.

**COMPANIA MINERA FRANCO-GALLEGA.** **SPAIN.**

Controls copper properties at Monforte, Lugo, Spain.

**FRANKLIN MINING CO.** **MICHIGAN.**

Office: 15 Congress St., Boston, Mass. Mine office, Hancock, Houghton Co., Mich. Mines are active, and large producers, employing about 600 men. Organized April, 1857, under Michigan laws, and reincorporated, 1887, for 30 years. Capitalization $2,500,000, in 100,000 shares, par $25. Francis H. Raymond, president; Daniel L. Demmon, secretary and treasurer; Joshua D. Hosking, superintendent. Directors are preceding officers, Geo. H. Flint and Josiah Q. Bennett. Cyrus Truan, mining captain at old Franklin, succeeding the late Capt. Thos. Kelly, who met death by falling down a shaft; Nicholas Clymo, mining captain at Franklin Junior; John Daniell, mining engineer; Arno Jachnig, clerk; Edw. Warne, mill superintendent.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,040,333.58 |
| Entire amount invested in real estate<br>(Since 1893—old books burned.) | 54,901.50 |
| Amount of personal estate | 184,748.14 |
| Amount of unsecured or floating debt | 84,825.60 |
| Production of copper, 1901, in pounds | 3,757,419 |

The landed estate of the company consists of 160 acres, on which the old

Franklin mine is located; 1,359 acres of surface, also mineral rights to 160 acres additional at the Franklin Junior, and a millsite of something less than 200 acres at Grosse Pointe with one mile frontage on Portage Lake. The old mine consists of the southwest quarter of Section 2, Town 55 North, Range 33 West. The Junior mine was opened as the Albany & Boston, in 1860. In 1882 the property was transferred to the Peninsula company, and in 1895 was bought by the Franklin, which immediately began work at that point.

The old Franklin is a "scram," though a valuable one. It is producing 100,000 tons or upwards of stamp-rock yearly, and can do so for several years to come. The shafts have long since reached the Quincy boundary line, the lode being cut off to north, south and west by the Quincy. Only two shafts are worked, these being No. 3, which is 3,200′ deep at the 32d level, and No. 5, which is 2,850′ deep at the 28th level. Mining is confined to scramming old ground and robbing pillars. The two lower levels have been gutted, and the process of slicing down pillars will be continued, working upwards. The pillars are usually rich, while the reworked ground varies greatly, ranging from almost worthless up to the best grade of stamp-rock and heavy copper. One mass weighing upwards of 13 tons was found in the reworked ground.

The old Franklin has suffered more from fire than any other Lake Superior mine except the Calumet & Hecla, many fires having occurred under circumstances pointing strongly toward incendiarism. The old stampmill was burned November, 1898, rendering the mine idle until the completion of the new mill, August, 1899. No. 3 shafthouse was burned September, 1901, and rebuilt December, 1901. No. 5 shafthouse was burned August, 1901, and put in commission again in exactly one month. Merely a headgear is now used, all rock being crushed at No. 5 rockhouse. No. 5 shaft has a Bullock hoist, with 26x48″ cylinders, raising two-ton loads from the bottom of the mine. Water is pumped to the mine and location from Portage Lake. The "west lode," opened 1901, by crosscut from the old workings, proved disappointing, and is not being developed.

The Franklin Junior has two separate mines, these being the old Albany & Boston, on the Allouez conglomerate, and the mine opened on the Pewabic amygdaloid by the Franklin company, the latter lying 475′ west of and parallel with the first-named mine. The amygdaloid shafts are numbered from north to south, the first being the north shaft, about 900′ south of the Rhode Island line and approximately 1,000′ deep; No. 1 shaft is 1,100′ next south and is down about 1,600′; No. 2 is 1,500′ further south and about 1,200′ deep; No. 3 is 1,100′ next south and is about 400′ in depth. The four shafts are sunk at an angle of 48° 30′. The lode varies in width from 3′ to 15′, averaging probably 9′. Average returns secured from this lode were about 0.45%, or 9 lbs. refined copper per ton of rock crushed. The amygdaloid shafts were closed December, 1901, and abandoned February, 1902. At 2,000′ to 2,500′ depth a cross cut may be sent to the amygdaloid from the conglomerate workings.

The results given by the Pewabic amygdaloid were so unsatisfactory that the old Albany & Boston mine, on the Allouez conglomerate, was reopened in

1900. No. 1 shaft was cut down to 3-compartment size, giving an inside measurement of 6½x18½'. Six-ton skips were installed in 1902, and both compartments put in use. Power is furnished by a direct hoist, good for one mile depth. Water is forked from the conglomerate openings by a Cornish pump, with 10" lift, the largest in the Lake district. This is doing very efficient work, and is probably handling water as cheaply per foot-gallon as is done by any pump in Michigan. The shaft is about 1,600' deep at the close of 1902, and sinking. A second shaft is needed, and is to be sunk at once, about a quarter-mile south of No. 1.

The conglomerate averaged about 0.75% refined copper, when worked by the former owners. It is said to be averaging somewhat better at present, due to closer milling, and is also said to be more regular in contents than formerly. The lode averages 18' to 22', running above 30' wide at points. Practically everything broken is milled, as at the Atlantic. Thirty power drills are running and 16 drifts are going. The combination shaft-rockhouse at No. 1 conglomerate is 40x50' on the ground and 96' high. There are 3 air compressors, of 10, 12 and 36-drill capacity, respectively. There are well equipped carpenter, blacksmith and machine shops, with other necessary buildings, and a large number of good dwellings for workmen.

In addition to the Pewabic amygdaloid and Allouez conglomerate, the Franklin Junior tract carries the Mesnard epidote, Calumet conglomerate and Osceola and Kearsarge amygdaloids, all opened by a long cross-cut. The Mesnard bed carries fine copper, but is narrow. None of the other lodes were of promising appearance where cut.

The stampmill is at Grosse Pointe and rock is transported by the Mineral Range railroad. It has three modern heads in commission, each good for 300 to 350 tons of conglomerate, or 450 to 500 tons of amygdaloid rock, daily. There is room for a fourth head, which, with supplementary machinery, would cost about $30,000. The mill now has 3 Allis-Chalmers stamps, 90 jigs and 10-double-deck slime tables. Two 500-h. p. Stirling boilers furnish steam for a 16x22" Allis-Chalmers engine. The steel mill building is 177x194', on stone foundations. A self-supporting brick-lined smokestack of 7' diameter stands 165' high on a 52' brick foundation. Water is furnished by an Allis pump of 15,000,000 gallons daily capacity, and there are electric lights throughout the buildings. There is a good wharf, 267' long, with 18' of water alongside, also coal sheds, and about 20 dwellings. Very satisfactory results have been secured at this mill, the cost of stamping having been only $.2575 per ton for 1901. Considering the large percentage of refractory conglomerate treated this was probably the cheapest milling done in the district that year.

The 1902 product of the Franklin was the largest ever secured. At present the conglomerate openings furnish about 800 tons daily, giving probably about 16 lbs. of refined copper per ton. The product for July, 1902, was 402½ tons mineral. The average of fine copper in Franklin mineral for 1901 was 68%, including heavy copper, and at present probably averages 60% to 65% refined copper. The Lake Superior Concentrating Co. is working the old mill sands, at Ripley, on a royalty.

Under the management of Capt. Hosking the Franklin has been worked with both vigor and prudence. The economies practiced have resulted in a cost-sheet that is highly commended by all men conversant with mining in the Lake district.

**FRASER MOUNTAIN COPPER CO.** **NEW MEXICO.**

Address: care of Albert C. Twining, Asbury Park, N. J. Mine office: Twining, Taos Co., N. M. Organized 1901, under laws of New Mexico, with capitalization $1,000,000, shares $1 par. Albert C. Twining, president; Wm. Fraser, vice-president and general manager; H. S. Taylor, secretary: Dr. Samuel Johnson, treasurer; Ralph R. Knowles, mill superintendent. Mineral lands, 400 acres, partly patented, also 7-acre millsite and 800 acres miscellaneous lands, in the Rio Hondo district of Taos Co., carrying 3 veins, all of which are more or less developed, principal vein running 50′ to 60′ wide and traceable 1,000′, showing oxide and carbonate ores, also chalcopyrite and bornite. Has a few shallow shafts and 6 tunnels. Has electric light plant, Pelton waterwheel, machine shops, air compressors, power drills, also hotel and general store. Has 100-ton concentrator, equipped with stamps, crushers, rolls, tables, etc. Smelter of 125 tons daily capacity was nearing completion at close of 1902. Ores said to average about 4% copper, with good gold and silver values. Employs about 135 men. Property is vigorously managed and company is composed of men of financial strength and good standing.

**FREE CUBA MINE.** **CALIFORNIA.**

At Acton, Los Angeles Co., Cal. Ira L. Houser, owner. Property first opened circa 1860; has a quartz vein 23′ wide carrying copper ore and native copper for width of 5′. Steam power; 12 men employed.

**FREEHOLD COPPER MINE.** **AUSTRALIA.**

At Newellton, Queensland. Ore carries 10% to 30% copper and 12 to 30 oz. silver per ton. Was developing in a very small way at last accounts.

**FREELAND MERCANTILE & MINING CO.** **COLORADO.**

At Freeland, Clear Creek Co., Colo. W. N. Smith, superintendent. Mine opened by shafts and tunnels; ore carries gold, silver, copper and lead; steam power; about 40 men employed.

**FREMONT COPPER MINING CO.** **WYOMING.**

Office: Fremont, Neb. Mine office: Riverside, Carbon Co., Wyo. Thos. Carroll, secretary and superintendent. Property, near Purgatory Gulch, Carbon Co., is being developed by 225′ shaft and tunnel now driving. Excellent assays have been secured. Property is vigorously managed.

**FRENCH CREEK MINES.** **PENNSYLVANIA.**

An old copper property in Chester Co., Pa., long idle.

**FRESNO COPPER CO.** **CALIFORNIA.**

Mine office: Pollasky, Fresno Cal., Co. H. G. Vercoe, superintendent. Four shafts now sinking, and steam plant to be installed. Vein supposed to be 50′ wide. Average assay value of ore, 7% copper and $2 gold per ton.

**FRIDAY & LOWDEN GROUP.** **CALIFORNIA.**

At Redding, Cal. Owned by Friday & Lowden, of Redding. Opened mainly by tunnels.

**FUELTA FALSA GROUP.** **SPAIN.**

Includes San Vicente and other mines, at Paimogo, Huelva, Spain. Undergoing investigation by Don Miguel Iglesias, of London, for Sres. Aznar y Ca., of Bilbao.

**FULTON MINE.** **COLORADO.**

A small property, 9 miles from Ribera, Colorado, which shipped several carloads of good copper ore to the smelter at Cerillos during 1902.

**FUNATSU GROUP.** **JAPAN.**

At Funatsu, Hida, Japan. Considerable silver is secured as a by-product; annual production, about 200 tons refined copper.

**SOCIEDAD DE MINAS Y FUNDICION.** **CHILE.**

Owns the Portozuelo, Armonia, and 12 other mines, at and near Carrizal Alto, Freirina, Atacama, Chile. The Armonia has long been a large producer and is 1,200′ in depth.

**FURUKAWA COPPER CO.** **JAPAN.**

Office: Mitsu Bishi Bldg., Yayescho, Kojimachi, Tokio, Japan. This company, of which Mr. Ichbei Furukawa is president, is much the largest copper producer of Japan, and is one of the leading copper mining companies of the world, and is noted for its progressiveness. The principal mines controlled by the company are the Ashio and Kusakura groups.

The Ashio mines are located in the Province of Shimotsuke, Japan, and were opened early in the Sixteenth century, the production being at the rate of about 1,500 tons annually at the beginning of the Eighteenth century. The property was secured, by the present owners, in a moribund condition, in 1871, but has been brought up to large production and great prosperity by careful management and liberal expenditures. Present output is about 8,000 long tons of refined copper yearly, and the mine employs 3,000 men. Deepest shaft is now down about 1,600′, and the mine is equipped throughout with hoisting and smelting machinery from American and German manufacturers. Mr. K. Asano, of Tokio, is consulting engineer and Messrs. R. Kondo and M. Otagawa, of Tokio, are associated in the management of the mine. Considerable trouble has been had at the smelter from the sulphur fumes and acid waters, which have prevented the cultivation of adjoining lands—a serious matter in a country so densely populated as Japan.

The Kusakawa group is located in the Province of Echigo and was purchased in 1876 by the Furukawa company. The mines were opened in the Eighteenth century and their present production is about 1,500,000 lbs. annually.

**COMPALIA GADITANA DE MINAS.** **SPAIN.**

Offices: Cadiz, Spain. Is operating in a limited way at Aznalcollar, Sevilla, Spain.

**GAGNON MINE.** **MONTANA.**

At Butte, Silver Bow Co., Montana. Owned by the Colorado Mining & Smelting Company.

**GALENA MINE.** **MONTANA.**

At Morris, Madison Co., Mont. D. A. Clapp, manager. Has gold, silver and copper ores; developed by tunnel.

**GALIZURSKI WORKS. RUSSIA.**

Located in the government of Elizabethpol, Russia. S. Varavov, proprietor. Production for 1899 was 38,494 poods refined copper.

**GAP MINE. PENNSYLVANIA.**

This old property, in Lancaster Co., Pa., was a large producer of nickel and a small but regular producer of copper, secured as a by-product, until closed in 1893 by the competition of the nickel-copper mines at Sudbury, Ontario.

**GARDNER HILL MINE. NORTH CAROLINA.**

At Jamestown, Guilford Co., N. C. An old mine, idle at last accounts, having 3 veins of chalcopyrite disseminated in pyrite, ranging from a few inches to 3′ wide, and opened by 110′ shaft.

**COMPANIA MINERA GARDUNA Y ANEXAS. MEXICO.**

At Coyuca, Guerrero, Mexico. No returns secured.

**GARFIELD MINING CO. UTAH.**

Supposed to be opening a copper mine by tunnel, near Brigham, Box Elder Co., Utah, but no returns secured.

**GARLOCK MINE. CALIFORNIA.**

Near Garlock, Kern Co., Cal. E. T. Garlock, superintendent. Has steam power and 10 stamps; was employing 15 men at last accounts.

**GARRISON GOLD & COPPER MINING CO. UTAH.**

Has a group of 21 claims on Dutch Mountain, near Ibapah, Utah.

**GEIGER MINE. COLORADO.**

At Apex, Gilpin Co., Colo. E. Steffon, owner; shaft and tunnel; steam power; gold, silver, lead and copper ores; small force employed.

**SUCESION FRANCISCO GEISSE. CHILE.**

Office: El Espino, Combarbala, Chile. Operates El Espino mine, opened 1896, and secures an annual production of 25 to 50 tons refined copper.

**GEISSE HERMANOS. CHILE.**

Operate copper mines, opened 1875, in the department of Illapel, Chile, producing about 150 tons of copper yearly.

**GEMINI MINING CO. UTAH.**

Office: Salt Lake City, Utah. Mine office: Eureka, Juab Co., Utah. John Q. Packard, president; E. W. Packard, vice-president; J. E. Berkely, secretary; L. S. Hills, treasurer; Jackson C. McChrystal, general superintendent. Produces gold, silver and copper, and has paid dividends of $300,000. Ended 1902 with a surplus of about $100,000. Mine shows a 20′ vein of argentiferous and auriferous copper ore, assaying 3% copper on the 1,600′ level. Is likely to materially increase its copper production, which heretofore has been merely a by-product. Has steam and water power.

**GENERAL ELECTRIC MINE. ARIZONA.**

At Clifton, Graham Co., Ariz. Cal. Reardon, superintendent. Has steam power and was working about 25 men at last accounts.

**GEORGE THIRD MINING, MILLING & SMELTING CO. COLORADO.**

At Carson, Hinsdale Co., Colo. M. L. Child, superintendent. Secures a little copper as a by-product from gold-silver-lead ores; shaft and tunnel; steam power; about 20 men employed.

**GERONA COPPER CO., LTD.** **SPAIN.**

Offices: 3, Clements Lane, London, E. C., Eng. H. Limebeer, secretary. Company is investigating the mines Dona Trinidad, Don Rafael and Pura Manolin, in Gerona, Spain.

**GERONA COPPER & LEAD MINES, LTD.** **SPAIN.**

Offices: 19-21, Queen Victoria St., London, E. C., Eng. C. A. Escott, chairman; A. H. Greenhill, secretary. Capital, nominal, £80,000. Property, 17 copper and lead mines, near Susquead, Gerona, Spain.

**GERTRUDE MINE.** **ONTARIO.**

See Lake Superior Power Co.

**GERTRUDE MINING CO.** **WYOMING.**

Has copper claims, opened by shaft and tunnel, near Battle, Carbon Co., Wyo., and was working about 20 men at last accounts.

**GIANT MINING CO.** **BRITISH COLUMBIA.**

In Yale & Cariboo district, British Columbia. Is developing gold and copper prospects; steam power; employs about 25 men.

**GIANT LEDGE GOLD & COPPER CO.** **CALIFORNIA.**

Office: 500 Frost Bldg., Los Angeles, Cal. Mine office; Manvel, San Bernardino Co. Cal. Employs about 15 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par, non-assessable. L. M. Gregory, president and general manager; V. L. Gregory, vice-president; H. R. S. Gregory, secretary; R. W. Kenny, treasurer; directors are preceding officers, Andrew Glassell and F. S. Stoddard. E. Brough, mining captain. Property, 19 claims, 4 patented, area 245 acres, also 20-acre millsite, in the New York district of San Bernardino Co. Five miles from Santa Fe railway. Formation reported as a continuous mother-lode fissure vein and a contact vein between limestone and granite, also offshoots from the mother vein. Dimensions of ore body given as 40′ width by 2,000′ length, and 200′ depth. Estimated values, 6% copper, considerable lead, $10 gold and 20 oz. silver per ton. Ores, oxides and sulphides of copper, with more or less galena. Has one 50′ shaft and tunnels of 70′ and 264′ on the vein. Has about 1,000′ of underground openings with 50,000 tons of ore in sight. During 1903 company will ship high-grade ores, and concentrate lower grades; probably will erect reverberatory furnaces also for matting. Property apparently valuable and is being conservatively handled.

**COMPANIA MINERA LA GIBOSA Y ANEXAS.** **MEXICO.**

A copper property, at Jiminez, Chihuahua, Mexico, regarding which no details have been secured.

**GILA VALLEY COPPER CO.** **ARIZONA.**

Letter addressed to company at Safford, Graham Co., Ariz., returned by postmaster, October, 1902, with statement that company had dissolved.

**GILBERT & NORRIS.** **MEXICO.**

Are operating a copper property at Zacatecas, Mexico. Mine opened by shaft and tunnel; gasoline hoists; about 40 men employed.

**GILBREATH BROS.** **IDAHO.**

Address: Gilbreath Bros., Shoup, Lemhi Co., Idaho. Lands, 11 unpatented claims, area 220 acres, also 260 acres of placer ground, showing 6 fissure veins, of which 2 are opened by 7 tunnels of 60′ to 300′, with 1,000′ of underground openings, veins averaging 12′ in width and 1,000′ length, and assaying 7% copper, $1 gold and 2 oz. silver per ton. Ores, oxides and carbonates, mixed with chalcocite. Will continue development on Copper King and Mayflower veins during 1903.

**GIRILAMBONE COPPER MINING CO., LTD. AUSTRALIA.**

At Girilambone, Cambelego Co., Nyngan Division, N. S. W. Mine was opened 1880; present company organized October, 1896. W. Blakemore, mine manager. Production in 1898, about 300 tons. A little silver is secured as a by-product. Ores occur as oxides, carbonates and sulphides, in a gangue of schistose and arenaceous slates, with numerous quartz veins and inclusions, in a country rock of slates and sandstones, having occasional hard bands of quartzite, the ore occurring as disseminations and replacements, without the defined limits of ordinary fissure veins. Alteration zone extends down about 200′. Deepest shaft, 520′. Ores are divided into three classes for treatment: the carbonates (including cuprite), with an average assay value of 4.6% forming the first class; oxides from the transition zone making the second class, and sulphides from the lower workings constituting the third grade, each class being smelted separately. Reduction is greatly hampered by deficiency in sulphur and iron, and excess of silica, which is the exact reverse of the usual difficulties experienced in smelting copper ores. Water supply is very scant and causes trouble in times of drought. Mine has a dam and is compelled to filter and re-use the water repeatedly. Smelter has 5 reverberatory furnaces and one refining furnace, product being turned out as blister copper of the exceptional purity of 99.95%.

**GLADSTONE MINE. ARIZONA.**

At McCabe, Yavapai Co., Ariz. J. W. Parsons, owner; L. Martin, superintendent. Is developing a copper and gold prospect by shaft, with horse power and a few men.

**GLASDIR COPPER MINES, LTD. WALES.**

Office: East Parade Chambers, Park Row, Leeds, Eng. Mines at Dolgelly, North Wales; company has been using the Elmore process of oil concentration. Debenture holders said to be in possession of the property.

**GLASGOW & WESTERN EXPLORATION CO. NEVADA.**

Mine office: Galena, Lander Co., Nev. Jos. Farron, superintendent. Recent assays from the Adelaide group give 15% to 20% copper, $2 gold and 5 oz. silver per ton. Has steam power and works about 20 men.

**GLEN-JENNINGS COPPER MINING CO. WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. M. J. J. Jennings, superintendent. Was developing with small force at last accounts.

**GLOBE TRACT. MICHIGAN.**

A tract of 3,200 acres, comprising Sections 1, 2, 3, 4 and 5, in Town 53 North, Range 35 West, Houghton Co., Mich. Owned by John Stanton, 11 William St., New York. Property explored by diamond drills during 1901 and 1902; much trouble experienced on account of the exceptionally heavy overburden of sand and boulders. It is thought, at the close of 1902, that the Baltic lode has been located. Developments are watched with great interest, as the Baltic amygdaloid has been proven one of the greatest cupriferous lodes in the Lake Superior district, and the Champion mine, next north of the Globe, is securing the richest copper-bearing rock of any mine in the Lake district, except the Calumet & Hecla.

**GLOBE COPPER MINING CO. WYOMING.**

Office: 24 Giddings Blk., Colorado Springs, Colo. Mine office: Hecla, Laramie Co., Wyo. Employs 25 men. Organized 1901, under laws of Colorado, with capitalization $1,500,000, shares $1 par. A. C. Widdicombe, president; J. A. Morrison, vice-president and general manager; John H. House, secretary; Robt. H. Widdicombe, treasurer. Directors are preceding officers, Edgar Hawbert and Chas. S. Fuller. Stewart Davis, superintendent; Prof. H. C. Beeler, consulting engineer; Edw. F. Browne, mining engineer. Lands, 22 claims, 20 patented, area 438 acres, in the Silver Crown district of Laramie county, showing various fissure veins, of which 3 are being developed, these averaging 7′ width and 200′ length, with estimated average values of 12% copper, $5 gold and 6 to 10 oz. silver per ton, from sulphide ores. Has 5 shafts, average depth 100′, also tunnels of 90′ and 160′. Steam power; air compressor, power drills, pumps, etc. Will sink main shaft 300′, develop ore bodies and install 60-ton concentrator in 1903.

**GLOBE-BOSTON COPPER MINING CO. ARIZONA.**

Office: Leavenworth, Kansas. Eastern office: 253 Broadway, New York. Mine office: Globe, Gila Co., Ariz. Organized under laws of Arizona, with capitalization $2,000,000. E. W. Crancer, president; J. H. Johns, vice-president; W. F. Kennedy, secretary; W. C. Schott, treasurer; Geo. S. Andrus, superintendent. Company has expended about $75,000 on development work. Main shaft 375′ deep. No returns secured.

**GODIVA MINING CO. UTAH.**

Office: Eureka, Juab Co., Utah. J. H. McChrystal, superintendent. Has gold-silver-copper ores; is equipped with steam power; works about 75 men.

**GOLD BUG MINE. COLORADO.**

At Empire, Clear Creek Co., Colo. W. B. Clough, superintendent; has gold, silver and copper ores; veins opened by tunnels.

**GOLD BUG CONSOLIDATED MINING CO. WASHINGTON.**

Mine office: Bossburg, Stevens Co., Wash. F. H. Merritt, superintendent. Is developing gold, silver and copper ores, by shaft, with small force.

**GOLD & COPPER CO. OF BINGHAM. UTAH.**

Office: 600 McCornick Bldg., Salt Lake City, Utah. Mine office: Bingham Canyon, Salt Lake Co., Utah. No returns secured.

**GOLD & COPPER CONSOLIDATED MINING & MILLING CO. ARIZONA.**

Office: 84 Adams St., Chicago, Ill. Mine office: Prescott, Yavapa Co., Ariz. Employs 50 men. Organized 1901, under laws of Arizona, with capitalization $4,000,000, shares $1 par, non-assessable. R. A. Sweet, president and treasurer; Robert Thompson, vice-president; J. B. Pogue, secretary;

A. J. Pickrell, general manager. Directors are preceding officers, G. K. Leet, A. J. Oehring, F. Lancaster, B. N. Schwartz, M. M. Pierce, Jas. Little and John Meredith. J. Chidister, superintendent. Lands, 25 claims, area 680 acres, in the Hassayampa and Big Bug districts of Yavapai Co., showing numerous fissure veins carrying oxide, carbonate and sulphide ores, with estimated average value of 7% copper, $38 gold and 46 oz. silver per ton, also undetermined lead values. Has 34 shafts, of 10′ to 500′, also 21 tunnels, of 20′ to 800′, with about 9,000′ of underground openings and 150,000 tons of ore blocked out for stoping. Has complete steam power equipment, with hoists, shops, etc., also a 50-ton concentrator, fully equipped, and a stamp mill. Company will continue development in 1903. Is operating conservatively and securing good results.

**GOLD & COPPER DEEP TUNNEL MINING & MILLING CO. NEW MEXICO.**

Mine office: Elizabethtown, Colfax Co., N. M. L. J. Burt, president; Jas. Lynch, secretary; W. P. McIntyre, manager. Lands, 105 acres, in the Moreno district of Colfax Co. Has 2 shafts and long tunnel. Copper ores are auriferous; no returns secured for 1902.

**GOLD & COPPER FIELDS SYNDICATE, LTD. AUSTRALIA.**

Offices: 5–6, Great Winchester St., London, E. C., Eng. A. A. Fraser, chairman; G. Addison-Scott, secretary; L. Parker, mine manager. Capital, nominal, £65,000. Lands, about 850 acres, in the parish of Byng, County Bathurst, New South Wales.

**GOLD & COPPER MINING CO. NEW MEXICO.**

Supposed to have property near Mora, Mora Co., N. M. No returns.

**GOLD HILL COPPER CO. NORTH CAROLINA.**

Office: New York City. Mine office: Gold Hill, Rowan Co., N. C. Walter G. Newcomer, president. Property is the old Gold Hill mine, which was of importance many years ago. Company was cleaning out old workings and had reached a depth of 720′ at last accounts. On the 600′ level a blind vein was cut, showing good assay values in copper, gold and silver. Property and company well spoken of locally.

**GOLD KING CONSOLIDATED MINES CO. COLORADO.**

Mine office: Silverton, San Juan Co., Colo. Davis & Soule, managers; W. Z. Kinney, superintendent. Ores carry gold, silver and copper. Mine opened by tunnel; equipped with steam and electric power; has 80-stamp mill. Employs about 100 men and secures a little copper as a by-product.

**GOLD MOUNTAIN MINING CO. WASHINGTON.**

Mine office: Berlin, King Co., Wash. F. Karl, superintendent; ores carry gold, copper and antimony; opened by tunnel; water and electric power; employs about 25 men.

**GOLDSMITH COPPER CO., LTD. BRITISH COLUMBIA.**

At Howe Sound, Burrard district, B. C. Company is developing gold, silver and copper ores, with about 20 men.

**GOLDEN KEY MINE. WASHINGTON.**

At North Bend, King Co., Wash. Wilson Tebbetts, owner. Employs small force driving tunnel on veins showing gold, silver and copper ores.

**GOLDEN MINT MINES, LTD. NORWAY.**

Offices: Throgmorton House, Copthall Ave., London, E. C., Eng. E. Page, chairman; A. Loberg, mine manager; A. C. Whitmee, secretary. Capital, nominal, £250,000. Property, 220 acres, including gold and copper claims, at Eidsvold, Norway. The Lyngenfjord copper mine is owned and operated in a small way by this company.

**GOLDEN RULE COPPER MINING & SMELTING CO. ARIZONA.**

Office: 220 Broadway, New York. Mine office: Vail, Pima Co., Ariz. Organized 1901, with capitalization $1,000,000, shares $1 par. W. H. Lake, president; Wm. Herring, vice-president; John B. Hibbard, secretary and treasurer. Lands, 17 claims, 10 of which are about 7 miles from Oracle, and 7, comprising the Cuprite mines, are near Vail. Development at the Cuprite includes a 140′ shaft. Property near Oracle not working at last accounts. Financial affairs of the company understood to be in poor condition.

**GOLDEN STAR MINING CO. IDAHO.**

Supposed to have gold-copper claims near Doniphan, Blaine Co., Idaho. Letter to that address returned unclaimed, November, 1902.

**GOLETA CONSOLIDATED MINES. CALIFORNIA.**

Mine office: Jordan, Mono Co., Cal. Hugh W. Nelson, superintendent. Is primarily a gold mine, but is developing a six-foot vein of chrysocolla; 40-stamp mill and cyanide plant; water power; employs about 75 men.

**SUCESION P. GONZALES. CHILE.**

Operates the Labrar mine, opened 1900, in the department of Freirina, Chile, and makes therefrom the equivalent of about 700 tons of refined copper yearly, shipped as matte.

**GOOD HOPE MINE. ARIZONA.**

Near Prescott, Yavapai Co., Ariz. Owned by Jas. Chambers. Carries gold and copper ores. No returns secured.

**GOODLANDER MINING & MILLING CO. MEXICO.**

Office: 603 New Ridge Bldg., Kansas City, Mo. No returns secured.

**GOOD VENTURE COPPER MINING CO. NEW HAMPSHIRE.**

Was prospecting near Woodsville, Grafton Co., N. H., circa 1890. Letter returned unclaimed, October, 1902.

**GOODVENTURE MINING & MILLING CO. WYOMING.**

Mine office: Hecla, Laramie Co., Wyo. Theo. Grout, superintendent. Is developing a copper vein by shaft and tunnel, with about 10 men.

**GOULD MINING CO. WYOMING.**

Owns the Helen Gould, Empire and adjoining claims, near Centennial, Albany Co., Wyo. These properties are on the summit of Centennial Mountain and are said to show a good vein of gold-copper ore, assaying 30% copper and $50 and upwards in gold per ton.

**GRAHAM COUNTY MINING CO. ARIZONA.**

Office: 1509–20 Broad St., New York. John W. Manning, president; Wm. G. Leland, vice-president; Schuyler S. Moore, secretary and treasurer. Property supposed to be in Morenci district of Graham Co., Ariz. No returns secured.

**LA GRAN PROVEEDORA DE COBRE.** **MEXICO.**

This is the Mexican corporation controlled by the Arizona & Mexican Copper Co.

**GRANBY CONSOLIDATED MINING, SMELTING & POWER CO.** **BRITISH COLUMBIA.**

Office: 62 Canada Life Bldg., Montreal, Quebec. Mine office: Phoenix, B. C. Smelter office: Grand Forks, B. C. Employs about 500 men. S. H. C. Miner, president; Jay P. Graves, vice-president and general manager; A. C. Flumerfelt, assistant general manager; G. N. Gaylor, second assistant manager and purchasing agent; G. W. Wooster, treasurer; A. L. White, secretary; R. R. Macaulay, assistant secretary; W. Yolen Williams, mining superintendent; A. B. W. Hodges, smelter superintendent. Mines are at Phoenix, smelter and principal operating offices are at Grand Forks. The Knob Hill and Old Ironsides are the principal mining properties, these having shipped 231,762 tons of ore in 1901. Ore bodies are very large but of low grade. Knob Hill is worked open-cast, as a big quarry, and railroad trains are run into the pits and loaded by steam-shovels. Is sinking a 5-compartment shaft on the Victoria claim, which has a central position in the group. Is installing a 60-drill electric Rand compressor, in 2 parts of 30 drills each, housed in a building 60x112'. Also has a 50-ton ore crusher, with daily capacity of 150 tons. The smelter at Grand Forks is of 1,600 tons daily capacity, having 4 furnaces, each 44x160" at the tuyeres, and 2 stands of converters, this being the largest reduction plant in Canada. Product is shipped as blister copper. Smelter was greatly hampered during last half of 1902 by shortage of coke supply. This is a very promising property.

**GRAND CENTRAL MINE.** **UTAH.**

Mine office: Tintic, Juab Co., Utah. Is primarily a gold-silver mine, with considerable values in copper, secured as a by-product.

**GRAND GULCH MINING CO.** **UTAH.**

A small shipper near St. George, Washington Co., Utah, F. W. Jennings, superintendent. Is said that shipments of 1,000 tons made from November, 1899, to August, 1902, returned an average of 44% copper, 5 oz. silver and $1 gold per ton. Wagon haul from mine to smelter is 180 miles, freight charges aggregating $29 per ton. Ores are oxide and carbonate, and veins are said to be large, but somewhat irregular, Property is apparently of value, if shipping facilities were furnished.

**GRAND MARAIS COPPER MINING CO.** **MINNESOTA.**

Letter sent to 2 Sherman St., Chicago, Ill., former address of company, returned unclaimed, October, 1902. Mineral lands were in Cook Co., Minn., showing native copper sparingly, in amygdaloidal rocks in the northern fold of the Keweenawan synclinal.

**GRAND MT. LYELL COPPER CO., LTD.** **TASMANIA.**

Property, near Mt. Lyell, Montague County, Tasmania. At last accounts, in spring of 1902, was working 11 men, driving a prospecting tunnel in Section 1674, and trenching in Sections 682 and 789.

**GRAND PRIZE COPPER MINING CO.** **ARIZONA.**

Mine office: Payson, Gila Co., Ariz. Dr. John A. King, superintendent. Opened by shaft; equipped with steam power; has three stamps and 60-ton smelter. Was attached by Bank of Arizona for debts, in spring of 1902.

**GRAND RAPIDS COPPER CO.** **WYOMING.**

Office and mines: Encampment, Carbon Co., Wyo. Organized under laws of Wyoming, with capitalization $100,000, shares 10 cents par. A. L. Conger, president; E. C. Johnson, vice-president; E. R. Clemens, secretary and treasurer. Supposed to be developing copper claims in the Encampment district of Carbon county. No returns secured.

**GRAND REEF MINING CO.** **ARIZONA.**

At Aravaipa, Graham Co., Ariz. Said to be opening a gold-silver-copper property, by shaft and tunnel, with force of 15 men.

**GRAND REPUBLIC COPPER CO.** **WYOMING.**

E. L. Black, president. Property in Carbon Co., Wyo. At last accounts company was negotiating for sale of property to the Saginaw Valley Copper Company.

**GRAND REPUBLIC COPPER MINING CO.** **COLORADO.**

Office: 52-240 La Salle St., Chicago, Ill. Mine office: Pearl, Larimer Co., Colo. Employs 9 men. Organized 1902, under laws of Wyoming, with capitalization $1,500,000, shares $1 par, non-assessable. W. A. McGuire, president; W. B. Waters, vice-president; E. B. Boisot, secretary and treasurer; L. D. Godshall, general manager; Samuel Fields, superintendent. Lands, 7 claims in process of patenting, area 70 acres, in Big Horn district of Larimer Co., Colo. Has steam power. A sulphide ore body is being developed by 125′ shaft. Company contemplates expending $10,000 on underground development in 1903.

**GRANDVIEW MINING & MILLING CO.** **UTAH.**

Office: probably Memphis, Tenn. Lands, in Utah, near the Colorado line. Ores give good assay values in gold, copper and silver. No returns secured.

**MINA GRANDE Y COBRE GRANDE.** **MEXICO.**

Said to be operating near Fronteras, Sonora, Mexico. No returns secured.

**GRANITE CREEK SMELTING & REDUCTION CO.** **NEVADA.**

Mine office: Golconda, Humboldt Co., Nev. Martin Lindley, manager; copper and gold ores; opened by shafts; steam power; employs about 25 men.

**GRANT COPPER MINING CO.** **COLORADO.**

Office: Encampment, Wyo. Mine office: Pearl, Larimer Co., Colo. Organized 1901, under laws of Wyoming, with capitalization $1,000,000. Leo Davis, president; C. W. Taylor, vice-president; H. D. Ashley, secretary; Theo. Davis, treasurer. Lands, 3 claims, one-half mile from Pearl. Vein said to be 12′ wide and to give average assay values of 10% copper. Company contemplates installation of mining machinery in 1903.

**GRASLITZ MINES.** **AUSTRIA.**

At Graslitz-Klingenthal, Bohemia, Austria. These mines are of great antiquity, and afforded one of the principal sources of European copper supply during the middle ages, but were abandoned toward the close of the Seventeenth century, remaining idle until September, 1901, when the work of reopening was begun. The vein is 12′ to 15′ wide, in clay-slate. A new smelter is being built, and the mine reopened on a large scale. A force of about 1,000 men was employed, underground and on surface, at last accounts.

**O. B. GRAY COPPER CO.** **NEW JERSEY.**

Incorporated May, 1901, with capitalization $250,000, to open a copper mine on the farm of O. B. Gray, near Pennington, N. J. Ore vein said to be 30′ wide and one-half mile long. No returns secured; company probably not working.

**GRAY EAGLE & HARD TIMES MINES.** **COLORADO.**

At Silver Cliff, Custer Co., Colo. Said to be working 15 men on a vein showing copper, gold, silver and lead; opened by shafts; steam power.

**GRAYTON COPPER MINES CO.** **COLORADO.**

Organized late in 1902, to develop the Greyton group of claims, 3 miles north of Pearl, Larimer Co., Colo. Said to have a good surface showing.

**GREAT BELCHER GOLD & COPPER CO.** **ARIZONA.**

Offices: 89 State St., Boston, Mass., and Real Estate Trust Bldg., Philadelphia, Pa. Mine office: Providence, Yavapai Co., Ariz. Letter returned unclaimed from Philadelphia, November, 1902. Chas. B. Cramp, president; D. F. Murphy, secretary. Management of mine supposed to be at loggerheads, and development at a standstill.

**GREAT CENTRAL FREEHOLD MINES, LTD.** **AUSTRALIA.**

Mine office: Mt. Hope, Blaxland Co., N. S. W. Organized January, 1876, with capitalization £80,000, shares £1 par. Paid dividends of £202,000 to close of 1899. Production in 1898 was 110 tons; present production probably 400 tons or more yearly, and to be increased. Oxidized zone extends to depth of about 250′, below which only chalcopyrite is found. The gangue of the oxidized ores is a decomposed porphyry, the sulphide ores occurring in brecciated porphyry. The country is arid and water supply scant. Plant greatly improved in 1901 and mines now have a good equipment. Company also owns the Mt. Allan mine, 11 miles distant from the Great Central.

**GREAT COBAR COPPER MINING SYNDICATE.** **AUSTRALIA.**

Mine office: Cobar, Robinson Co., N. S. W. Smelter at Lithgow, N. S. W. Dr. Richard Reed, mining director, Sydney, N. S. W.; W. Longworth, general manager, Lithgow; G. H. Blackmore, mining manager, Cobar. This is the most important copper producer of New South Wales. The mine was opened 1869 and closed 1892, after making 26,611 long tons of fine copper, securing an average return of 11.07% copper. Tributors took property on 10-year lease in 1892. Production for 1898 was 2,520 tons of fine copper. Ores carry considerable gold values. Property, 1,100 acres of freehold, including the townsite of Cobar. Mine works 3 veins dipping vertically, known as the East, Middle and West lodes, principal operations being on the latter. Ore is bismuthiferous, but the bismuth is well eliminated in smelting, the Lithgow smelter being noted for its successful handling of this refractory element. The West lode is 70′ wide at points on the 90-fathom level. Mine worked 20 stopes in 1901. The "New" shaft is 892′ deep. Operations are hampered by an occasional scarcity of water at the mines.

This company controls the Great Cobar mine, Nymagee copper mine, Great Bear gold mine and Lithgow Copper Smelting & Refining Works. The mine manager writes that the company is a private syndicate and does not give out any statement of operations.

The Nymagee copper mine, at Nymagee, Priory Plains, Mouramba Co., N. S. W., was opened 1880, in a country rock of slates and sandstones. The main ore body is chalcopyrite, 15′ to 20′ wide in a section 250′ long, returning 10% copper. Mine is about 750′ deep and produces 500 to 750 tons refined copper yearly. Smelting is by the pyritic process, with a reverberatory furnace for blowing up the matte to blister copper, which assays 99.75% fine.

The Cobar smelter, at Lithgow, has 5 water-jacket cupola furnaces of 100 tons daily capacity each. The grade of the ore smelted has run down from 18% in 1878 to about 7% at the present time. Product is turned out as blister copper, carrying about $40 per ton in gold and silver values. An electrolytic plant for refining the blister copper was installed 1901–1902.

**GREAT FREEHOLD MINE. AUSTRALIA.**

In the Mt. Perry district of Queensland. Was a small producer in 1901; no returns secured for 1902.

**GREAT LAKES COPPER CO. ONTARIO.**

Address: care of Exploration Co., 15 Broad St., New York. Organized 1900, under laws of West Virginia, with capitalization $3,000,000, shares $5 par. John McKinley, president; Horace Williston, secretary; Robert Sloane Bickford, treasurer. Lands, upwards of 4,000 acres, near Sudbury, Algoma, Ontario, carrying nickeliferous chalcopyrite in a gangue of pyrite. Has several shafts, deepest 150′, also open cut. Has a considerable amount of ore in sight. The Graf smelting process was tried, but proved a failure. Property mortgaged to secure money to pay debts. Affairs of corporation are in chaotic shape, and no satisfactory information is furnished shareholders.

**GREAT LAKES MINING & MILLING CO. WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. B. E. Burger, superintendent. Development shaft 170′ deep at last accounts.

**GREAT LAKES MINING & SMELTING CO. WYOMING.**

Office: Manitowoc, Wis. Mine office: Encampment, Carbon Co., Wyo. Isaac Craite, president; R. W. Burke, vice-president; J. V. Miller, secretary; C. H. Seeger, treasurer; F. C. Miller, manager. No returns secured.

**GREAT MAMMOTH COPPER MINING CO. WASHINGTON.**

Office: 45 Milk St., Boston, Mass. Mine office: Index, Snohomish Co., Wash. Organized under laws of Washington, with capitalization $1,500,000. J. L. Rice, president. Has 10 claims adjoining the Index-Independent mines. No returns secured.

**GREAT MOUNT LYELL COPPER CO., LTD. TASMANIA.**

Offices: Blomfield House, London, E. C., Eng. T. J. Ide, chairman; R. T. Moore, manager; J. T. B. Hickson, agent, Hobart, Tasmania. Property, 639 acres, held on 21-year lease from 1898, at £160 annual rental. About 3,000′ of underground openings have been made, and narrow veins found at two points. Property idle, at last accounts from Tasmania.

**GREAT NORTHERN MINING CO. WASHINGTON.**

Mine office: Baring, King Co., Wash. J. Waggoner, superintendent. Said to be developing a mine by tunnel, with force of 10 men.

**GREAT REPUBLIC COPPER & GOLD MINING CO. ARIZONA.**

John M. Sullivan, president, Prescott, Ariz.; F. E. Jordan, secretary, Jerome, Ariz. Lands, 30 claims, area about 600 acres, including the Columbia group, on Lower Turkey Creek. Yavapai Co., Ariz. Has a 314′ tunnel, showing oxide and sulphide ores. Capitalized at $3,000,000. No returns secured.

**GREAT VERDE CONSOLIDATED MINE. CALIFORNIA.**

Office and mine: Sisson, Shasta Co., Cal. Is a copartnership, capital $20,000, with 4 owners. John Reed Lyle, secretary and treasurer. Has 12 unpatented claims, on the Iron Mountain copper belt of Shasta Co., adjoining the Balaklala mine, showing fissure vein or lense with estimated average width 80′ and length 5,000′, carrying chalcopyrite, giving assays 6% copper, $7 gold, 6 oz. silver per ton. Has 5 tunnels, longest 150′, and sells ore to the Keswick smelter. Owners will continue development in 1903.

**GREAT WESTERN COPPER CO. ARIZONA.**

Office: Clinton, Iowa. Mine office: Tombstone, Cochise Co., Ariz. Capitalization, $1,000,000. W. J. Young, Jr., president; P. B. Warnekros, manager; F. W. Knapp, superintendent. Lands, several adjoining claims, are in the Dragoon Mountains of Cochise Co. Has steam and gasoline power; understood to have a leaching plant. No returns secured.

**GREAT WESTERN COPPER CO. NEVADA.**

Office: 113 Devonshire St., Boston, Mass. Mine office: Reno, Washoe Co., Nev. Organized 1901, with capitalization $1,000,000, shares 10 cents par. Geo. D. Burton, president; Frank B. Cox, secretary. Lands, 62½ acres in the Pea Vine district of Washoe Co. Two shafts, deepest 200′, also 800′ tunnel. Assays give 12% copper, also gold values, from vein 2′ to 17′ wide. Has steam plant; no returns secured for 1902.

**GREAT WESTERN GOLD CO. CALIFORNIA.**

Address: care of Jas. J. Chambers, manager, Redding, Cal. Has recently purchased the Afterthought mine, in the Furnaceville district, 20 miles east of Redding, Shasta Co., Cal.. Mine has 200′ shaft and a number of drifts, showing a large body of sulphide ore. Company also owns the Liberty group, in the vincinity of Redding, carrying gold and copper, and is preparing to install a 125-ton smelter.

**GREAT WESTERN GOLD & COPPER CO. UTAH.**

Office: Salt Lake City, Utah. Mine office: Park City, Summit Co., Utah. Company supposed to be controlled by David Evans and Senator J.

L. Rawlins. Property adjoins the Daly-Judge and shows vein of 100′ width, giving assays of 3% to 5% copper.

**GREENBACK COPPER CO. MEXICO.**

Office address and location of mine not learned. Property supposed to be in Mexico.

**GREEN MONSTER MINE. NEVADA.**

At Sandy, Lincoln Co., Nev. Owned by Mrs. Phoebe Hearst, San Francisco, Cal. F. O. Wilkinson, superintendent. Has 325′ shaft, on vein carrying copper, silver and lead; employs 15 men.

**GREEN MOUNTAIN MINES. CALIFORNIA.**

Owned by O. R. Sydney, et al, La Grande, Cal. Property about 6 miles west of Raymond, Mariposa Co., Cal. Has not been worked since 1863; produced a considerable amount of high-grade oxide and carbonate ores when active. Old underground developments were quite extensive, on ore body of large size. Owners were arranging to explore property with a diamond drill, at last accounts.

**GREEN MOUNTAIN MINE. COLORADO.**

At Parkdale, Fremont Co., Colo. W. E. Johnson, owner. Copper and gold ores; opened by shaft; gasoline hoist; employs about 15 men.

**GREEN MOUNTAIN COPPER MINING CO. WYOMING.**

Sold to Saginaw Valley Copper Co.

**GREENE CONSOLIDATED COPPER CO. MEXICO.**

Office: 377 Broadway, New York. Mine office: La Cananea, Sonora, Mexico. Organized 1899, under laws of West Virginia, with capitalization $7,200,000, shares $10 par. Owns entire stock issue of Cananea Consolidated. Copper Co., which holds direct title to the Greene Consolidated mines. W. C. Greene, president; Mark L. Sperry, vice-president; Anson W. Burchard, second vice-president and comptroller; Geo. S. Robbins, secretary; Philip Berolzheimer, treasurer; W. C. Greene, M. L. Sperry, Edw. B. Tustin, Myron M. Parker, Philip Berolzheimer and Anson W. Burchard, executive committee. Directors are Charles Adsit, Thos. H. Anderson, A. Bleecker Banks, Emil Berolzheimer, Philip Berolzheimer, Henry F. Blount, Anson W. Burchard, H. E. Huntington, W. C. Greene, A. C. Latimer, George Mitchell, Henry Ollesheimer, Myron M. Parker, Edward C. Rice, Geo. S. Robbins, Alfred Romer, Henry T. Scott, J. B. Showalter, Mark L. Sperry, Edw. B. Tustin and J. Weidmann. Jas. H. Kirk, mining manager; Geo. Mitchell, smelter superintendent; Hal. W. Hardinge, mill superintendent; A. F. Mack, chief mining engineer.

This is one of the largest copper mines in the world. The property is of such magnitude and required such extensive development and equipment that it has been no easy matter to finance the company. The management has been accused of gross extravagance, but this charge is not substantiated by a careful examination of the company's operations, millions of dollars being required to open and equip a mine of such great size. The extent and value of the company's mines have been systematically depreciated in certain influential quarters, and the management has suffered no end of criticism, much of which was captious, but has survived, and the mine now ranks well to the front among the very largest copper producers of the globe. The annual report of the company for the fiscal year ending July 31, 1902, is one of the most complete and instructive ever issued by a mining corporation.

The capitalization was increased to $7,200,000 in November, 1902, by the issue of stock of the par value of $1,200,000, sold for the gross sum of $2,400,000, the proceeds being used to pay off a large floating indebtedness incurred in equipment. The company paid dividends of 2% in May, 1901, 2% in September, 1901, and has declared a 2% dividend, payable Jan. 2, 1903, on the total stock issue of $7,200,000. The company's balance sheet, for the fiscal year ending July 31, 1902, shows an actual investment of $7,293,294.33, the more important items being as follows:

| | |
|---|---|
| Investment in mines | $1,506,776.21 |
| Prospecting and development work | 1,309,216.40 |
| Railroads | 640,247.18 |
| Concentrator | 227,186.65 |
| Smelter | 704,791.23 |
| Converter | 266,250.32 |
| Power plant | 378,606.89 |
| Buildings | 271,317.39 |
| Real estate | 569,525.50 |

The statement shows credits of $243,000 for timber and wood from the company's timber lands, and $57,707.27 cash receipts from sale of building lots in the municipality of Cananea. Ten per cent. of the cost of machinery and equipment is deducted annually for depreciation. For the fiscal year 1902 the actual cost of mining and milling was 4.125 cents per pound, and gross costs were 6.5 cents per pound of copper made. Production for the year ended August 31, 1902, was slightly in excess of 34,000,000 lbs. The nominal capacity of the mine and plant at the close of 1902 is 6,000,000 lbs. of refined copper monthly, while actual capacity is probably slightly under 5,000,000 lbs. Company is now considering doubling present capacity, but this will require probably two years and an investment of further large sums. For August, 1902, the production was 3,370,000 pounds of copper, sold for $368,559.80, and produced an estimated net mining profit of $150,685.05. Miscellaneous charges for the month were $21,702.65 for administration and $10,211.67 for commercial charges. There was also an income of $2,167.92 from rentals; banking profits of $8,989.24 and store profits of $13,664.53, leaving actual net profit for the month's business at $144,086.18, making net cost of copper 6.67 cents per pound.

The mining lands of the company include 4,214 pertenencias of 1 hectare each, equivalent to 10,408 acres, the tract having a "coast line" of 32½ miles. These lands include about 40 old mines and prospects. Mining lands have been equipped with permanent triangulation stations, greatly facilitating both mining and surface surveys. The company also owns 486,000 acres of timber and grazing lands, the latter leased for 8 years to the Cananea Cattle Co. The mines are in the municipality of Ronquillo, but the company has platted the townsite of La Cananea in the municipality of that name, and has sold 588 lots for $57,727.27 and retains 828 lots therein. The company holds franchises for lighting, water, ice, street-railway and telephone service in La Cananea. There has been more or less litigation over titles. Lands were redenounced in 1902 and the company now holds patents direct from the Mexican government.

Twenty-seven miles of graded roads have been built on the company's mining lands, these having a maximum gradient of 7%, and twenty-two miles of trails have also been built. The company owns upwards of 400 horses, mules and burros, and has a large corral for their care. In addition to the concentrator, smelter, power plant and miscellaneous buildings, hereinafter described, the company owns 5 office buildings, 11 dwellings for foremen, boarding-houses with capacity for feeding 900 men, 6 lodging houses and about 200 cabins for miners. There are 3 boarding-houses of 10 rooms each, 1 of 16 rooms and 1 of 42 rooms, all of brick. Company also owns a restaurant, bakery, meat market, etc., and maintains a scavenger service in the municipality of Ronquillo. There is a two-story brick hospital, 40x100′, with detached kitchen and beds for 50 patients, also a 6-ward emergency hospital at the Capote mine. The mercantile plant includes a brick store-building, with warehouses having direct railroad connection. This carries a large stock, being practically a modern department store. The company also owns and operates the Banco de Cananea, organized January, 1902, with a capital of $200,000, Mexican, showing profits of $45,037.65 to close of business on July 31, 1902. There is a brickyard with a daily capacity of 35,000 brick. The company maintains a telephone system having about 200 miles of wire, one half copper, and about 100 phones. There is also an independent telephone system used for dispatching on the narrow gauge railway. A standard gauge railroad was built from La Cananea to Naco, Ariz., thus effecting a saving of 1 cent per pound on the cost of shipping copper to New York. This road has been sold to the Cananea, Yaqui River & Pacific R. R. Co., with which the Greene Consolidated has a 25-year freight contract on favorable terms. The Greene Consolidated has a private railroad of 36″ gauge, laid with 35 and 40-lb. steel rails, with maximum grade of 3½%, this line being 11 miles in length and touching at all of the principal shafts, concentrator, smelter, etc. The narrow gauge line is equipped with one 38-ton and one 40-ton Baldwin locomotive, and two 28-ton Porter locomotives, also ten 25-ton and twelve 30-ton steel ore cars, 3 coke cars, 4 flat cars, 2 box cars and a caboose. There are two sawmills with a combined capacity of 14,000 feet daily, cutting lumber from the company's timber lands.

The ores of the Greene are of great variety and extent. The mineral formation, extending for 7½ miles east and west along the company's main tract, apparently carries copper bodies of greater or less value for the entire distance. Ores are oxide, carbonate, and sulphide, with occasional native copper. The ores contain no refractory elements in important quantities, but concentration is required in the case of ores from the Capote and Veta Grande mines, which have large bodies of silicious ore running 3% to 7% copper and requiring considerable barren limestone or iron ore for fluxing, when smelted direct. These ores are concentrated to 20% or 30% copper values by the elimination of alumina and excess silica, and are then smelted to advantage, the ore reduced in 1901 giving average returns of 159 lbs. per short ton, or 7.95% copper.

The various old and new mine workings are divided by the company into 5 zones, these being known as the Cobre Grande, Veta Grande, Esperanza, Capote and Puertecitos. There are 8 main working shafts, also a large number of tunnels, the bulk of the ore extracted coming through tunnels. Veta Grande shaft No. 5 is 700′ deep; Capote shaft, 750′; Elisa, 540′, and Ventura, 700′. On August 1, 1902, the mine openings comprised 8,581′ of shafts and winzes, and 56,181′ of horizontal openings, including tunnels, drifts and crosscuts.

Developments on the Cobre Grande show a concentrating ore only, and this, not being of as good quality as found elsewhere in profusion, is not being worked at present. This mine has 1,314′ of shafts and 4,510′ of horizontal openings. No. 4 shaft furnishes a large part of the water supply for the surface operations.

The Veta Grande mines are producing about 500 tons of ore daily, with 200 men working. No. 5, the main shaft, has 3 compartments, working two cages in balance. At these mines there is a 986′ tunnel with 2 tram tracks. On the third level the ore body is 86′ to 410′, assaying 10% to 12% copper. There is also a 150′ ore body on the hanging-wall side averaging 3% to 6% copper, the silicious portions of which are used for converter linings. The motor tunnel, having a back of 500′, develops a very large ore body showing chalcocite with some cuprite and native copper. This ore is excellently adapted to concentration. No. 5 shaft has a 115-h. p. double hoist, good for 1,000′ depth, also a 7-drill air compressor, smithy, timber-framing sheds, etc. A crosscut will be driven from this shaft at a depth of 1,000′.

The Esperanza zone is but little developed as yet. It will be opened from the Capote shafts at a depth of 500′ to 600′.

The Capote zone has 3,898′ of vertical openings and 20,974′ of horizontal openings, the principal development of the Greene Consolidated properties being at this point. The mine requires about 10,000′ of timber daily, for underground work, and is sinking 4 shafts, Nos. 2, 4, 6 and 8. About 500 men are employed and the production crowds 1,000 tons daily, the smelting ore returning 8% to 10% copper. The main working level has a double track tunnel connecting shafts 2, 4, 5 and 7, at an extreme distance of 2,900′. This level is to be extended 340′ to the Oversight section of the Capote zone, which is now producing about 100 tons of high grade ore daily. The ore body is 225′ wide at the north end of the mine; 165′ wide at a point 460′ south and 186′ wide at a point 1,260′ south of the north end. No. 2 shaft has a 110-h. p. hoist and No. 4 has a powerful double hoist good for a depth of 3,000′. At No. 4 shaft there is a 7-drill air compressor and a 50-kilowatt direct-connected generator which furnishes light and power for the Capote workings. The Elisa mine, 1,500′ south of No. 2 Capote shaft, produces about 100 tons of 9% chalcopyrite daily, with a force of about 200 men. On the second level the ore is 20′ wide for a distance of about 500′ and averages 4% to 6% copper, while on the third level the vein maintains its width and carries about 10% copper.

The Puertecitos zone is about 4 miles northwest of the Elisa shaft of the

Capote and has 1,554′ of vertical openings and 6,181′ of horizontal openings, with a productive capacity of about 1,000 tons daily. The ore bodies are of immense size, the outcrop being about 800′ wide. Ores are chalcopyrite, bornite, malachite and azurite, in a lime-alumina-garnet gangue. The workings of the Puertecitos zone are known as the Ventura on the east, Juarez 1,200′ next west, and Elenita, 900′ west of the Juarez.

The surface plant is very extensive. The main power plant adjoining the smelter has a boiler house 46x216′, with steel frame and iron sides and roof, and coal bunkers with storage capacity of 3,500 tons. The engine house, of steel, is 65x245′; the machine shop is fully equipped and is supplemented by a foundry having a 2-ton cupola. Pneumatic tools are used extensively, power being furnished by a Rand compressor. There is also a carpenter shop and planing mill, with complete sash-and-door equipment. The shops are run by electricity and the plant for power and lighting is very complete. There are 3 engines with direct-connected dynamos of 100-kilowatt capacity each, and one engine of 200-kilowatt capacity, giving a total of 500 kilowatts, equal to about 700 h. p. The switch-board is 6x14′, of iron frame with marble panels. This plant furnishes a current at 250 volts to operate the various shops, silica mill, briquetting plant, electric cranes, etc., and furnishes light for the municipalities of Ronquillo and La Cananea.

The concentrator is between the mines and the smelter and is built in two independent sections of 300 tons daily capacity each, so planned that the output can be doubled at a cost of about 25% of the original investment. The concentrator stands on a steep slope and all material is handled by gravity, after being dumped into bins from narrow-gauge cars. The building has 34,000 square feet of floor surface, and equipment includes two 10x20″ Blake crushers, two 16x36″ rolls, four 14x27″ rolls, four 36″ single Hartz jigs, two 36″ double Hartz jigs, 44 concentrating tables and 4 slime tables. Material is treated by wet crushing and water concentration. Storage tanks have a capacity of 200,000 gallons. The power house has four 100-h. p. boilers, coal bins of 300 tons storage capacity and a tandem compound condensing engine of 250 h. p.

The furnace building is 33x296′, of steel frame with iron sides and roof. It is so built that full advantage is taken of the force of gravity in handling material, and has ore bins of 4,200 tons capacity and coke bins to store 3,000 tons of fuel. The nominal smelting capacity is 6,000,000 lbs. per month. The seventh furnace was blown in just before the close of 1902. There are 8 Mitchell hot-blast air-jacketed furnaces, one of 42x120″, one 42x180″, two of 42x210″, one 48x120″ and three 54x160″. Over each furnace is a steel dust chamber, 20x20x20′, which, after collecting the flue dust, returns the same to the smelting zone of the furnace, by gravity, thus greatly reducing the work of briquetting and resmelting the dust. The furnace-gases then go to a dust-flue 10x13x400′ long, and the dust is taken by conveyor to a brick-lined steel chamber 50x75x28′. The smoke and gases are discharged from the dust-chamber through a self-supporting steel chimney, 16′6″ in diameter and 190′ high.

There are 30-ton detached settlers before each furnace, giving a continuous discharge of slag into self-dumping slag-cars of which there are 22 with capacity of 30 to 52 cubic feet each, drawn to the slag dump by two 40-h. p. and two 25-h. p. electric locomotives. The matte is drawn off into ladles and taken by electric crane to the converter department. In the engine house of the smelter there are 3 blowing engines, one of which is a 225-h. p. Nordberg with 13x24" steam cylinder and 57x57x42" air cylinder, with a capacity of 20,000 cubic feet of free air per minute, and two Murray-Corliss tandem compound blowing engines of 125 and 375-h. p., also 3 smaller blowers, giving a total capacity of 1,100 h. p., and 92,500 cubic feet of free air per minute compressed to a pressure of 2½ lbs. per square inch. The boilers have 3,000 h. p. capacity and a 12" main steam line. Coal is fed by gravity from bins. The water-storage tanks at the smelter have a capacity of 596,000 gallons, with 9,303′ of water mains and 4,000′ of 2½" fire hose.

The converter building is 60x396′, of steel frame with iron sides and roof, fitted with electric traveling cranes covering the full span and length of the building, a 50-ton Morgan crane having a clear hoist of 40′. The capacity of the conversion plant is 8,000,000 lbs. per month. There are 5 stands of converters, with 22 shells 11′ in diameter by 13′ long, made of 1" steel plate. The hydraulic cylinders are 24" in diameter with a water pressure of 200 lbs. to the square inch, and can rotate the shells through a radius of 270°. The converters blow off into movable hoods leading to primary and secondary dust chambers for converter gases. A railroad track runs under each converter stand and casting cars are fitted with 6 moulds for 300-lb. ingots each, there being 24 cars and 250 moulds. When cast the ingots are carried in the cars to the bullion floor, where the pigs are chipped, weighed, sampled and loaded, all sampling being done by electric drills. The converter slags are taken back in ladles, by crane, to the forehearths, thus saving resmelting.

At the eastern end of the converter building is the lining department, with silica mill, pneumatic rammers, etc. All material is handled by gravity, from 600-ton silica bins. The silica mill has one 10x20" Blake crusher, two 26x15" Argall rolls, one 8′ automatic mixing-pan, conveyers, elevators, etc., and takes power from a 125-h. p. electric motor. The briquetting plant has a Mould plunger press of 225 tons and a White mineral press of 100 tons daily capacity. Briquettes are sent by belt conveyor to the charging floor of the furnace building. Power for the briquetting plant is furnished by one 5-h. p. and two 50-h. p. electric motors. Blast for the converters is supplied by 3 engines, of 1,700 aggregate h. p., with capacity to compress 29,750 cubic feet of free air per minute to a pressure of 15 lbs. per square inch.

The blister copper turned out by the Greene Consolidated is refined electrolytically by the United Metals Selling Co., at Perth Amboy, N. J., and by the Nichols Chemical Co. of New York.

One of the most serious problems in the operation of the Greene Consolidated is the question of water supply. Potable water is piped from Sawmill Cañon and is also secured from a well in Puertecitos Cañon, and from Capote Cañon for the Capote shafts, there being an aggregate daily supply of 100,000 gallons of potable water. For mine and smelter use and for fire protection No. 4 Cobre Grande shaft gives about 400,000 gallons daily; a well near the Cananea ranch furnishes 100,000 gallons daily; Ronquillo shaft supplies 80,000 gallons daily, and an uncertain supply of 25,000 to 100,000 gallons is secured daily from La Democrata Cañon, giving a daily supply of 600,000 to 700,000 gallons. The water system has tanks with a storage capacity of 762,584 gallons and has 72,818′ of water mains of 2″ to 8″. No water is wasted and the liquid is re-used wherever possible. The question of further and permanent water supply is receiving careful attention. It will be possible to get 3,000,000 gallons daily from Ojo de Agua by building a pipe line of 9 miles and pumping against a head of 900′. It is also possible to obtain a maximum supply of 10,000,000 gallons daily from the Magdalena river, 5 miles distant, by pumping against a head of 1,140′. In either case the installation and operation of an adequate water system will prove very costly.

The Greene Consolidated has by no means reached its maximum production. Estimates of a monthly output of 12,000,000 to 15,000,000 lbs. are not likely to be reached for some years to come, and such a production can be secured only by the expenditure of millions of dollars for further underground development and very extensive additions to the present surface plant. It is probable, however, that this company can increase its production to a maximum of nearly 75,000,000 lbs. per year, by comparatively slight additions to the present plant.

**GRIBBELL ISLAND COPPER CO. BRITISH COLUMBIA.**

Office: Fairhaven, Wash. Property, on Gribbell Island, Skeena River Division, Cassiar District, B. C. Company worked 40 men in 1901; no considerable ore bodies had been secured at last accounts.

**GRIFFITH WEST MINE. COLORADO.**

At Georgetown, Clear Creek Co., Colo. Owned by Hood & Maxwell. Opened by tunnel; carries gold, silver, lead and copper; worked a small force at last accounts.

**GRIGGSTOWN MINE. NEW JERSEY.**

At Griggstown, N. J. Reopened late in 1901. Old shaft was 100′ deep; work begun on new shaft; no returns secured.

**GUADALUPANA MINE. MEXICO.**

At Topia, Durango, Mexico. Felix Briones, owner. Produces copper-silver ores; opened by tunnel; employs about 40 men.

**GUADALUPANO MINING CO. MEXICO.**

Mine office: Torres, Sonora, Mexico. H. H. Douglas, manager. Employs about 100 men; has silver-lead-copper ores; developed by shaft; steam power; 20-stamp mill.

**GUAYNOPA SMELTING & REDUCTION CO. MEXICO.**

Address: care of Daugherty & Albers, 69 Wall St., New York. Mining lands, near Guerrero, Chihuahua, Mex. No returns in response to repeated requests.

**GUGGENHEIM EXPLORATION CO. MEXICO.**

Office: 71 Broadway, New York. This company is in the business of exploring, developing and selling mines in the republic of Mexico. Operates the Dolores y Anexas mines, at Matehuala, San Luis Potosi, Mex. Edw. Doerr, superintendent; developed by shafts and tunnels; gasoline power; employs about 200 men. Also operates a mine at Tepezala, Aguascalientes, Mex. R. Brendell, superintendent; has 500′ shaft; produces gold and silver; steam power; employs several hundred men.

**GULF CREEK COPPER CO., LTD.** **AUSTRALIA.**

At Gulf Creek, Barraba division, New South Wales, 350 miles north of Sydney and 72 miles from a railroad. Ore bodies are a 9′ vein of 7% sulphide ore, also a lense of sulphide ore 25′ wide and 350′ long, averaging about 10% copper, one stope for entire length having averaged 14%. Ore is chalcocite disseminated in pyrite, and is very heating, some stopes being too hot for the hand, and showing marked oxidation, with copper sulphate in the joints and elsewhere. Country rocks are indurated clay-stones of carboniferous age, with dykes of serpentine. Was working about 200 men at last accounts. Has a smelter. Production for 1901 was 560 long tons copper, from 9,400 tons of ore smelted.

**GYMPIE COPPER MINES, LTD.** **AUSTRALIA.**

Offices: Salisbury House, London Wall, London, E. C., Eng. Lieut. Gen. Sir J. B. Edwards, chairman; M. T. Wigham, secretary. Capital, nominal, £150,000. Property, 120 acres at Gallangowan, Fitzroy Co., Queensland. Work has been confined to prospecting; on Lot No. 25 a 15′ vein giving assay values of £6 per ton has been opened.

**HAGGARTY-JORDAN MINING CO.** **WYOMING.**

Office: Watertown, N. Y. Mine office: Battle, Carbon Co., Wyo. Employs 4 men. Organized 1901, under laws of Delaware, with capitalization $150,000, shares 10 cents par. C. H. Dunbar, president; Edw. Haggarty, vice-president; Delos S. Dunbar, secretary and treasurer; C. W. Jordan, superintendent. Directors are preceding officers and Gardner Kimball. Lands, 11 claims, 1 patented, area 220 acres, in Battle Lake district of Carbon Co., showing 4 fissure veins, of which 2 are being developed, these averaging 4′ wide and giving estimated average values of 35% copper, a trace of silver, and $5 gold per ton, from carbonate and sulphide ores. Shaft 90′, tunnel 100′, underground openings, 285′. Will continue development work in 1903.

**HALL MINING & SMELTING CO.** **BRITISH COLUMBIA.**

Offices: Leadenhall Bldgs., Leadenhall St., London, E. C., Eng. Mine office: Nelson, B. C. Lord Ernest Hamilton, chairman; A. E. Ashley, secretary. Capital, nominal, £325,000; issued, £275,000. Debentures, £50,000, 6% first mortgage bonds authorized, £24,560 issued. Property, 506 acres, including Silver King mine, on Toad Mountain, near Nelson, B. C. Ores are copper-silver. Copper in ores mined from Silver King mine has run down from 6.5% to about 3.8%. Ores are bornite above, with argentiferous tetrahedrite in lower levels. Has a smelter at Nelson, near the mine. Production of copper has been decreasing since 1897.

**HALLIWELL COPPER CO.** **MICHIGAN.**

Office: Cleveland, Ohio. Idle at present. Organized 1901, under laws of South Dakota, with capitalization $3,000,000, shares $1 par, non-assessable. Louis Poplowsky, president; A. H. Weed, vice-president; Chas. W. Voth, secretary, C. F. Uhl, treasurer; H. H. Reeves, superintendent. Lands, 880 acres, in Carp Lake Twp., Ontonagon Co., Mich., carrying sundry copper-bearing amygdaloids. Has two shafts, 130′ and 200′ with about 800′ of underground openings. Has steam power outfit. Mine is 17 miles from Chicago, Milwaukee & St. Paul Ry. Company contemplates sinking shafts on the Noble and Black Amygdaloid lodes, in 1903. Fully described in 1902 edition.

**HAMILTON MINE. MICHIGAN.**

The Hamilton group includes the Hamilton, Trap Rock, Essex and Windsor properties, in Ontonagon county, a few miles north of Matchwood, Mich. Area, 480 acres. A little mining work has been done in the past; Property is to be reopened in 1903.

**HAMILTON MINING, MILLING & TRANSPORTATION CO. COLORADO.**

Mine office: Winfield, Chaffee Co., Colo. John G. Payne, superintendent. Opened by shafts and tunnel; copper, silver and gold ores; employs a small force.

**HAMLEY MINES. AUSTRALIA.**

Address: care of John S. Scott, secretary, Grenfell St., Adelaide, South Australia. Mine office: Moonta, Yorke Peninsula, South Australia. Opened 1861 and formerly known as the Karkanullo mine. Deepest shaft, 1,020′ in 1899. Ores, bornite and chalcopyrite, yielding 1 to 4 tons copper per fathom of ore broken. Production, 100 to 150 tons yearly.

**HAMMOND COPPER CO. MONTANA.**

Office: formerly at 18 Broadway, New York, but company cannot be found by postal authorities. In litigation, with ugly charges made by shareholders, at last accounts.

**HAMPDEN COPPER MINES. AUSTRALIA.**

At Cloncurry, North Queensland. Worked March to August, 1901. Returns from 528 tons of ore shipped to Wallaroo for smelting averaged 36.5% copper. Has large bodies of sulphide ores, but cannot work at a profit unless given railroad connections or a smelter at the mine.

**HANAWA MINE. JAPAN.**

Owned by the Mitsu Bishi Gosshi Kwaisha.

**HANCOCK MINES CO. NEW MEXICO.**

Office: 100 La Clede Bldg., St. Louis, Mo. Mine office: Organ, Donna Ana Co., N. M. Employs 5 men. Organized 1902, under laws of New Mexico, with capitalization $1,000,000, shares $1 par. O. F. Clifford, vice-president; E. R. A. Misener, secretary; P. C. Compton, treasurer; Frank S. Cronk, superintendent. Lands, 4 unpatented claims, showing 3 fissure veins, of which one, carrying carbonate ores, is being developed. Has two 80′ shafts and tunnels of 204′ and 210′. Company contemplates building a 100-ton concentrator in 1903.

**HANCOCK MINING CO. MICHIGAN.**

Office and mine: Hancock, Houghton Co., Mich. August Mette, agent. Area, 160 acres, much of which is now built over by the city of Hancock.

Idle since 1885. Lode is narrow but fairly rich. Total production, 2,854 tons, 1,384 lbs. refined copper.

**HANE COPPER MINING CO.** **MONTANA.**

Office: Butte, Silver Bow Co., Mont. H. L. Elton, president. No returns secured.

**HANOVER COPPER CO.**

Office: 11 Broadway, New York. Organized under laws of South Dakota, with capitalization $1,000,000. C. W. White, president; R. K. Wartman, secretary. Company refuses to furnish any information, except that it is not mining.

**HAPPY CREEK MINE.** **NEVADA.**

Near Lovelock, Nevada. Frank Reynolds, superintendent. Said to give assays of 37½% copper, 20 oz. silver and $3 gold per ton. Ledge on surface is 60′ wide, in serpentine.

**HAPPY JACK MINING CO.** **ARIZONA.**

At Patagonia, Santa Cruz Co., Ariz. W. H. Bernett, superintendent. Vein opened by shaft and tunnel; ores carry gold, silver, copper and lead. Employs a small force.

**HAPPY JOHN MINE.** **BRITISH COLUMBIA.**

In Alberni division, Vancouver district, B. C. Shaft opened on vein carrying gold, copper and silver; small force employed.

**HARDSCRABBLE MINING CO.** **NEW MEXICO.**

Mine office: Magdalena, Socorro Co., N. M. A. C. Thomas, superintendent. Ores carry copper, silver, lead and zinc. Has steam power equipment and 80-ton smelter; was employing about 100 men at last accounts.

**OTTO HARNECKER.** **CHILE.**

Operates the Peña Blanca mine, opened 1888, in the department of La Ligua, Chile. Makes the equivalent of about 150 tons of refined copper yearly, product being shipped as matte.

**HARTFORD CONSOLIDATED COPPER CO.** **CALIFORNIA.**

Lands, 10 claims, 3 miles north of Protem Creek, Shasta Co., Cal. Wm. Geary, president; J. B. Griffen, secretary. Vein said to be 8′ wide with surface showing of oxidized ores; disseminated sulphide ores developed in limited quantities by 400′ of tunnels.

**HARTFORD COPPER & GOLD MINING CO.** **IDAHO & ALASKA.**

Office: 7 Exchange pl., Boston, Mass. Mine office: Challis, Custer Co., Idaho. Capitalization, $2,000,000. Henry J. Wikins, president; Chas. M. Thayer, secretary; John I. Minear, mine manager. Idaho property is 150 miles from a railroad, but is quite extensively developed, having about 1 mile of tunnels and drifts, longest tunnel being 900′. Has a 50-ton mill, working on low-grade ore, and ships more or less high-grade smelting ore, running $400 to $600 per ton. Also owns copper and gold claims on Prince of Wales Island, Alaska. Was paying quarterly dividends of 1% at last accounts. No returns secured from company.

**HARVARD MINE.** **ARIZONA.**

At Gilbert, Yavapai Co. Ariz. W. P. Hamlin, et al, owners; W. J. Gilbert, superintendent. Opened by shaft and tunnels; ores carry gold, silver and copper; gasoline hoist; employs small force.

**HATHAWAY MINE.** **MEXICO.**

Near Santo Domingo, Chihuahua, Mex. No returns secured.

**HATTIE GOLD & COPPER MINING CO.** **IDAHO.**

Address given as Doniphan, Blaine Co., Idaho, but letter returned unclaimed, November, 1902.

**HATTIE BELL COPPER, GOLD & NICKEL MINING CO.** **ONTARIO.**

Property sold to Consolidated Copper Co. of Parry Sound.

**HAWKEYE MINE.** **OREGON.**

At Comer, Grant Co., Ore. B. Sherbindy, owner. Has gold, silver and copper ores, in vein opened by tunnel; 10 men employed.

**HAWKEYE COPPER MINING CO.** **WYOMING.**

Property is in the vicinity of Battle, Carbon Co., Wyo. No returns secured.

**HAYMAN MINING & TUNNEL CO.** **COLORADO.**

Has a copper-lead property in the lower Tarryall camp, about 25 miles northwest of Cripple Creek, Teller Co., Colo.

**HEADLIGHT COPPER MINING CO.** **WYOMING.**

Office and mines: Encampment, Carbon Co., Wyo. Chas. A. Finley, president; Philip Lee, secretary. Lands, 180 acres. Ore is low grade. Property idle at last accounts; no returns secured.

**HEALDSBURG LODE.** **CALIFORNIA.**

Lands, one claim, 10 miles north of Healdsburg, Cal. J. G. Caldwell, Healdsburg, Sonoma Co., Cal., manager. Opened circa 1885, by tunnel; limited development work in progress at last accounts.

**HEATH MINING CO.** **IDAHO.**

At Heath, Washington Co., Idaho. E. P. Hall, manager. Has gold-silver-copper ores, opened by shaft; steam power; employs about 25 men.

**HECLA CONSOLIDATED MINING CO.** **MONTANA.**

A small property, securing an annual production of about 60 tons of refined copper.

**HECLA COPPER MINING CO.** **WYOMING.**

Capitalization $1,250,000. Lands, 4 claims, area about 30 acres, adjoining the Kurtz-Chatterton, in the Encampment district, Carbon Co., Wyo. No returns secured.

**HECLA COPPER & GOLD MINING, MILLING & SMELTING CO.** **WYOMING.**

Office: 331 Kittredge Bldg., Denver, Colo. Mine office: Hecla, Laramie Co., Wyo. Employs 8 men. Organized 1901, under laws of Wyoming, with capitalization $1,000,000, shares 5 cents par, non-assessable. Henry Schwartz, general manager and president; Geo. C. Norris, vice-president; Emerson J. Short, secretary; J. H. Schwartz, treasurer; Wm. H. O'Reilly, mining captain. Lands, 14 claims, one patented, area about 280 acres, also 30-acre townsite, 5-acre millsite and 10-acre smeltersite. Has 14 fissure veins, said to have average width of 8′ and average assay value of 5% copper,

$10 gold and 3 oz. silver per ton; ores also carry nickel, platinum and uranium. Ores, oxide, carbonate and sulphide. Has 14 shafts, from 10′ to 140′ and 40′ tunnel. Has 40-ton concentrator; ore goes to smelter at Hecla, two miles distant. Company contemplates continuing development and enlarging concentrator and mill in 1903. Company estimates production of refined copper at 3,000 pounds for 1902, and announces that it will pay a 5% dividend in January, 1903.

**HECLA & ARIZONA GOLD & COPPER MINING CO. ARIZONA.**

Incorporated, July 1902, by Arizona and Texas parties, including J. M. Carroll and C. T. Clark, of Bisbee, Ariz. No returns secured.

**HELEN MINING CO. NEW MEXICO.**

Mine office: Graham, Socorro Co., N. M. Thos. Graham, president. Has gold-silver-copper ores, with 30-stamp mill and is equipped with steam, water and electric power. Operates the Confidence group, with force of about 75 men.

**HELGA GOLD & COPPER CO. BRITISH COLUMBIA.**

An American corporation, address not secured. Is opening copper claims 7 miles from Clayoquot, on west coast of Vancouver Island, B. C. About $25,000 has been expended; no production as yet; showing said to be promising.

**HELSINGBORG'S KOPPERVERK. SWEDEN.**

In Malmohus Lan, Sweden. Production in 1901 was 647,884 kilograms of cement copper, averaging 75.5% fine, and 1,166 kilograms of silver precipitate, averaging 5.2% fine.

**HELVETIA COPPER CO. ARIZONA.**

Office: 27 State St., Boston, Mass. Mine office: Helvetia, Pima Co., Ariz. Organized 1899, under laws of New Jersey, with capitalization $5,000,000, shares $25 par; $3,750,000 issued. Wm. A. Paine, president; Frederick Stanwood, secretary and treasurer. Directors are preceding officers, F. A. Gilbert, S. L. Smith, Jas. B. Seager, Jas. R. Cooper, J. H. Rice and K. K. McLaren. Annual meeting, third Wednesday in February. Lands, 55 patented claims, area 1,100 acres, also 900 acres miscellaneous lands, in the Helvetia district, 30 miles south of Tucson. Mine had exceptionally fine showing of oxidized ores on surface, but these turned to sulphides on the third level and averaged under 5% copper. First smelter was burned in 1900 and rebuilt 1901, with daily capacity of 150 tons. Property closed down early in 1902, being unable to work at a profit on 11-cent copper. Installation of a leaching plant has been suggested.

**HENRIETTA MINE. ARIZONA.**

At Bigbug, Yavapai Co., Ariz. Barnes & Wilson, owners. Has gold and copper ores; steam plant and 10-stamp mill; employs about 20 men.

**HENSON CREEK LEAD MINES CO. COLORADO.**

Mines in Hinsdale Co., Colo. P. T. Newett, manager; I. Moreau Smith, superintendent. Mines are opened on silver-lead veins, which have turned into copper-lead veins at depth. No returns secured.

**HERCULES CONSOLIDATED MINING CO.** **COLORADO.**

Mine office: Silverton, San Juan Co., Colo. Thos. H. Kane, superintendent. Has 40-stamp mill and secures a little copper, as a by-product, from cupriferous gold and silver ores.

**HERCULES GOLD & COPPER CO** **NORTH CAROLINA.**

Office: 135 Broadway, New York. Mine office: Cid, Davidson Co., N. C. Employs 75 to 100 men. Organized 1901, under laws of South Dakota, with capitalization $1,000,000, shares $1 par. Wm. C. Anderson, president H. L. Prentice, vice-president; R. E. Neuse, secretary; Samuel S. W. Brown, treasurer and general manager; John Jackson, superintendent; A. J. Beck, mill superintendent. Lands, 1,000 acres, also about 1,000 acres timber and miscellaneous lands, in Davidson Co., N. C., showing 3 fissure veins averaging 3′ width and 1,600′ length, carrying estimated average values of 6% copper, $1.50 to $3.50 gold and 3 to 17 oz. silver per ton, in ores mainly sulphide. Has shafts of 75′, 300′ and 475′, also 12 tunnels with about 3,000′ of underground openings, and 50,000 tons of ore blocked out for stoping. Steam power hoist, pumps, etc. Is erecting a 50-ton Allis-Chalmers water-jacket furnace at the mine. Nearest railway, 14 miles. For 1903 will continue sinking 3 shafts and drifting; attention will also be given to a number of prospects on which little or no work has been done as yet.

**HERCULES MINING CO.** **WYOMING.**

Office: 523 Bee Bldg., Omaha, Neb. Property idle. Capitalization, $1,000,000, shares $1 par. C. M. Jacques, president and general manager; H. H. Quinlan, vice-president; J. E. Thatcher, secretary and treasurer. Lands, 4 claims, one patented, area about 80 acres, showing fissure veins averaging 9′ wide with assay values 5% to 49% copper. Ores are carbonates and sulphides. One shaft, 280′; tunnel, 90′. Steam and gasoline power.

**HERMIT LAKE COPPER CO.** **COLORADO.**

Office: 31 Milk St., Boston, Mass. Mine office: Silver Cliff, Custer Co., Colo. Organized 1899, under laws of Maine, with capitalization $2,000,000, shares $20 par. John H. Norton, president; Oliver J. Kimball, secretary; Nelson W. Kimball, treasurer. Annual meeting, first Saturday in October. President writes, Dec. 29, 1902, that the property is only a prospect and that company is to be reorganized.

**LAS HERRERIAS MINE.** **SPAIN.**

General Spanish office: Manriques 9, Cordoba, Spain. Mine office: Puebla de Guzman, Huelva, Spain. Owned by C. & J. Sundheim, heirs of Señora Viuda Riecken, and operated under lease by Bede Metal & Chemical Co., of Hebburn-on-Tyne, England. Lands, 7 mines, in two groups of government concessions, area 136 hectares. Employs 300 men. Operated since 1895. Richard E. Carr, general manager in Spain. Percy E. O. Carr, mining engineer. Ore body is a large, irregular mass of solid pyrites in schist, carrying an average of 1½% copper and 47% sulphur. Ore in sight is estimated by manager at 250,000 tons, and by other authorities much higher. Has 1 shaft, 70 metres deep. Mine is worked open-cast, with 2 mineral floors, each about 16 metres in height. Ore is weathered before treatment.

Property has an excellent machinery plant. Ore, when mined, is piled in extended heaps, 5 to 8 metres in height, and sprinkled systematically. The leach liquor is let off through long narrow channels containing pig or scrap iron, and the cement copper secured is dried and shipped in bags to the smelters at Newcastle-on-Tyne. Production of ore has ranged from 14,724 metric tons up to 51,786 metric tons in 1899, in which year 577 long tons of refined metal were secured. Production for 1902 was about 41,000 tons of ore containing about 590 metric tons of copper.

**HETTA MOUNTAIN GROUP. ALASKA.**

Near Copper Harbor, Prince of Wales Island, Alaska, in north latitude 59°. Lands, 8 claims; is asserted that property has vein 2′ to 20′ wide and 3,000′ long, averaging 10% copper, $2 gold and 3 oz. silver per ton.

**HETTIE GREEN GROUP. BRITISH COLUMBIA.**

Address: care of Jas. Thompson, owner, Alberni, B. C. Property, located on Tranquil Creek, Vancouver, B. C., is said to give a good showing of chalcopyrite and bornite.

**HIDALGO MINING CO. MEXICO.**

Office: Douglas, Cochise Co., Ariz. S. F. Maguire, president; E. R. Pirtle, secretary. Property is in the Nacozari district of Sonora, Mex., and comprises 3 distinct groups of claims; main group is 200 acres, carrying ore assaying 15% to 30% copper, and $2.50 to $8.50 gold per ton; principal development work has been done on this group. Two miles southward is another group of claims giving assays of 11% copper, $4 gold and 200 oz. silver per ton, from a vein 11′ to 15′ wide.

**HIDDEN TREASURE GROUP. CALIFORNIA.**

At Callahans, Siskiyou Co., Cal. Owned by Alger Bros. Said to have a 100′ tunnel on 8′ vein of disseminated ore with quartz gangue; was developing at last accounts.

**HIDDEN TREASURE MINING & MILLING CO. WASHINGTON.**

Mine office: Methow, Okanogan Co., Wash. Jos. West, Seattle, Wash., treasurer. Organized 1896. Ninety tons of ore shipped to smelter gave returns of $67 per ton. Has fissure vein 2′ to 4′ wide, with ore chutes 8′ to 10′, vein traversing gneiss and carrying chalcopyrite, galena and sphalerite, in quartz and calcite gangue.

**HIDDEN TREASURE MINING & TUNNEL SITE CO. WYOMING.**

Mine office: Battle, Carbon Co., Wyo. H. M. Rice, manager. Has been developing by long tunnel for past two years. No returns secured.

**HIDDEN TREASURE & WEST POINT MINES. MONTANA.**

At Clinton, Missoula Co., Mont. W. J. Stevens, owner. Opened by tunnels; developing at last accounts.

**HIGH HILL MINE. VIRGINIA.**

Owned and operated by Virginia Copper Co., Ltd.

**HIGHLAND BOY GOLD & COPPER MINING CO. UTAH.**

Stock owned by Utah Consolidated Gold Mines, Ltd.

**HIGH LONESOME GOLD MINING & MILLING CO. COLORADO.**

Located near Coulter, Colo. H. C. Merlich, president, Pueblo, Colo.;

Dr. W. E. Rammel, secretary and treasurer, Curtis St., Denver, Colo.; E. S. Reardon, vice-president and superintendent. Organized 1902, with capitalization $500,000. Ore body, exposed by open cut, said to be 38′ wide; ores give 18% to 21% copper, and one-half oz. gold per ton. Developing by tunnel; is to have a 10-stamp mill.

**HIGH ORE GOLD & COPPER MINING CO.** **MONTANA.**

Supposed to have property in vicinity of Basin, Jefferson Co., Mont., but letter to that address returned unclaimed, November 1902.

**HIGH TOP COPPER MINING CO.** **VIRGINIA.**

Office: 32 Broadway, New York. Mine office: Elkton, Rockingham Co., Va. Employs 125 men. Organized 1902, under laws of New Jersey, with capitalization $5,000,000, shares $10 par, non-assessable. Morris D. Brown, president; Jas. G. Blauvelt, vice-president; Prentice W. Brown, secretary and treasurer. Directors are preceding officers, Wm. P. Richardson and Geo. A. Treadwell. S. D. Brown, general manager; Robt. D. Crawford, mining captain. Land, 400 acres, owned in fee, with mineral rights to 540 acres additional, in Greene Co., Va., 7 miles from Norfolk & Western R. R. Has 3 fissure veins, traced for practically a mile. Estimated ore values, 6% copper, $15 gold and 10 oz. silver per ton. Veins show carbonate and sulphide ores and native copper. Has 75′ shaft. Complete steam equipment. Company contemplates erecting 200-ton reduction plant and estimates output for 1903 at 3,600,000 pounds refined copper. Large water power available on Shenandoah river, 5 miles distant. Principal vein, showing sulphide ore, is very wide, and will be worked open cast.

**LA HIGUERA MINE.** **CHILE.**

A copper producer of some importance, near Coquimbo, Chile, from which no returns have been secured.

**HILLSIDE COPPER MINING CO.** **NEVADA.**

Office: 201 Exchange Bldg., Denver, Colo. Mine office: Pioche, Lincoln Co., Nev. Organized under laws of Nevada, with capitalization $2,000,000, shares $1 par. Wm. Gelder, president; M. E. Buffington, secretary; J. E. Gelder, treasurer. Was employing 30 to 40 men in 1901. Idle at last accounts; no returns secured.

**HODGES HILL MINE.** **NORTH CAROLINA.**

In Guilford Co., N. C. Was worked in a limited way, many years ago, on a 6′ to 12′ vein carrying chalcopyrite in a quartz gangue.

**HOFMAN CLAIMS.** **CALIFORNIA.**

At Ukiah, Cal. A group of 4 claims, area about 80 acres, in Lake Co., Cal., giving assays of 6% copper, $5 gold and 2 oz. silver per ton, from carbonate and sulphide ores.

**HOFRET EL NAHAS MINE.** **SUDAN.**

In Southwest Kordofan, Anglo-Egyptian Sudan. Is worked in a small way to meet purely local demands. Ores are smelted in a primitive manner, at the mine.

**HOLDEN EXTENSION GOLD & COPPER MINING CO.** **WASHINGTON.**

W. J. Bowen, secretary and general manager; capitalization, $1,500,000. Property, 2 acres on the Holden lode, near Chelan, Chelan Co., Wash.

**HOLLAND MINE.** **ARIZONA.**

Near Washington, Santa Cruz Co., Ariz. G. W. Crowe, superintendent. Has steam plant and crusher; ores carry copper, gold, silver, lead and zinc.

**HOLLOWAY MINE.** **NORTH CAROLINA.**

In the Virgilina district of Person Co., N. C. Owned by W. E. C. Eustis, Boston, Mass. Has considerable development, deepest shaft being 510′, in a chute of chalcocite. Ore is shipped to Norfolk, Va., for reduction.

**HOLMES MINING & MILLING CO.** **WISCONSIN.**

Office and mine: Mellen, Ashland Co., Wis. Organized 1902, under laws of Wisconsin, with capitalization $150,000, shares, 25 cents par. C. A. Poundstone, president; John Holmes, vice-president; A. W. Petersen, secretary and general manager; J. R. Whittaker, treasurer; Philip McDonald, superintendent. Lands, 80 acres, in the Penokee district of Ashland Co., showing three veins carrying sulphide ore and native copper, also 30 oz. silver and $3.70 gold per ton, with a little palladium. Is developed by 140′ shaft; equipped with steam power; will drift at depth of 200′.

**HOME COPPER CO.** **ARIZONA.**

Mine office: Morenci, Graham Co., Ariz. John Molder, superintendent. Is developing by shaft; has steam power.

**HOME COPPER CO.** **WASHINGTON.**

Supposed to have property near Cle-Elum, Wash. No returns secured.

**HOME COPPER MINING CO.** **MICHIGAN.**

Has a 240-acre tract on the mineral belt, adjoining the Humboldt mine, Keweenaw Co., Mich. Never a producer. Address of company not learned.

**HOME COPPER MINING CO.** **MONTANA.**

Office; presumably Butte, Silver Bow Co., Mont., but letter to that address returned November, 1902. Lands, 9 claims, in Meagher Co., Mont. Has shaft about 200′. Sample carload of ore shipped to smelter returned better than 30% copper. Idle at last accounts.

**HOME GOLD & COPPER CO., LTD.** **NOVA SCOTIA & ONTARIO.**

Office: 1104 D. S. Morgan Bldg., Buffalo, N. Y. Has sundry gold and copper claims in Nova Scotia, Ontario and New Mexico. Advertises stock very extensively but furnished no returns for this work in response to repeated. requests.

**HOMESTAKE MINE.** **ARIZONA.**

At Gilbert, Yavapai Co., Arizona. J. B. Burson, et al, owners; Chas. Taylor, superintendent. Is developing a vein carrying gold and copper, by shaft; has gasoline power; employs about 15 men.

**HORN SILVER MINING CO.** **UTAH.**

Office: 52 Broadway, New York. Mine office: Frisco, Beaver Co., Utah. Organized 1879, under laws of Utah, with capitalization $10,000,000, shares $25 par. Allan C. Washington, president; Juan M. Ceballos, vice-president; Ambrose I. Harrison, secretary and treasurer; P. T. Farnsworth, manager. Produces gold, silver, lead, copper and zinc. Has good surface equipment and 30-stamp mill. Employs 150 to 200 men. Production of copper for 1901 was 577,578 lbs. The old Bonanza mine shows good copper values at a depth of 800′, mainly on the hanging-wall, with silver-lead ores favoring the foot-wall.

**HORSE SHOE COPPER MINING CO. ARIZONA.**

Former office: Park Row Bldg., New York. Mine office: Safford, Graham Co., Ariz. Ignatius L. Quayley, president; Frank S. Weller, secretary. Both officers under indictment for grand larceny, and president was dodging the police, at last accounts. Complaints were made by 3 shareholders that Qauyley and Weller were implicated with "Larry" Summerfield and "Baker Tom" Putnam, high-grade professional crooks, in relieving them of approximately $15,000 cash. Control of the property understood to have passed into hands of another corporation.

**HORSESHOE GOLD MINING CO. COLORADO.**

At Central City, Gilpin Co., Colorado, W. H. Scheur, superintendent. Ores show gold, silver and copper; opened by shaft; equipped with steam power.

**HOULIHAN GOLD & COPPER MINING CO. ARIZONA.**

Office: Los Angeles, Cal.; not found by postal authorities. J. T. Whedon, president; Geo. Houlihan, vice-president; Geo. C. West, secretary and treasurer. Has mining property near Jerome Junction, Yavapai Co., Ariz.

**HOWARD COPPER CO. MONTANA.**

Former office: 18 Broadway, New York. Letter to that address returned December, 1902, with notation "Removed; present address unknown." Organized under laws of South Dakota, with capitalization $1,500,000, shares $1 par. Lyman N. Loomis, of Butte, Mont., president and treasurer; Jos. C. Howard, of New York, secretary; Ralph M. Jacoby, who has successfully promoted a large number of unsuccessful mining companies, was vice-president at last accounts. President is spoken of as an honorable man. Lands, 60 acres, 10 miles north of Phillipsburg, Granite Co., Mont. Company has done more or less development work on these claims and was driving a tunnel in June, 1902. Has been stated in a Phillipsburg paper that control of the property passed into the hands of residents of Maryland, in July, 1902. No definite returns secured from any official.

**HOWLE COPPER MINES. ARIZONA.**

Address given as Globe, Gila Co., Ariz. No returns secured.

**COMPANIA HUANCHACA DE BOLIVIA. BOLIVIA.**

Offices: Rue du General Foy, 46, Paris, France. P. Vilamil, agent. Operates La Playa Blanca mine, opened 1892, in the department of Antofagasta, Chile. Property supposed to be making 1,500 to 2,000 tons of refined copper yearly.

**HUDSON MINE. COLORADO.**

At Granite, Chaffee Co., Colo. Ball & Henrieson, owners; W. H. Ball, superintendent. Ore body showing gold, silver and copper is being opened by tunnel.

**COMPAGNIE DES MINES DE CUIVRE DE HUELVA. SPAIN.**

Offices: Brussels, Belgium. Mines, including Numancia, Sagunto and Taoro, are at La Granada, Huelva, Spain. In process of development.

**SOCIEDAD PYRITES DE HUELVA. SPAIN.**

Mines office: Calañas, Huelva, Spain. In process of exploration and development.

**HUELVA CENTRAL COPPER MINING CO., LTD. SPAIN.**

Offices: Dashwood House, London, E. C., Eng., and Rue de Seze, 4, Paris, France. Comte B. de Puchesse, president; E. Gaudet, vice-president; G. Gaudet, managing director; A. J. Rawlinson, secretary. Capital, £490,000; debentures £100,000 first-mortgage 6% bonds. Property: 13 copper claims, area about 4,000 acres, including the Cueva de la More mine, at Almonaster, Huelva, Spain. Mines recently reopened, and in process of exploitation. Railroad line of 4½ kilometers building from Valdelamusa to mines.

**HUERFANO GOLD & COPPER MINING CO. COLORADO.**

Organized under laws of Kentucky to develop prospects near Ojo, in Sierra Blanca district of Huerfano Co., Colo. No returns secured.

**HUESCA COPPER, IRON & LEAD MINES, LTD. SPAIN.**

Offices: 19-21, Queen Victoria St., London, E. C., Eng. Capital, nominal, £150,000; company registered Sept. 17, 1900; object of incorporation, to acquire copper, iron and lead mines in the Province of Huelva, Spain. No returns secured.

**HULETA GOLD & SILVER MINING CO. MEXICO.**

Mine office: Valardena, Durango, Mexico. Carter Barker, superintendent. Mine is opened by shafts and equipped with steam power. Ores carry gold, copper, silver and lead. Employs about 50 men.

**HUMBOLDT MINE. NEW MEXICO.**

At Fierro, Grant Co., N. M. Schlosser & La France, owners. Copper ore body is being developed by shaft, with small force.

**HUMBOLDT COPPER CO. MICHIGAN.**

Office: 50 State St., Boston, Mass. Organized 1863, under Michigan laws, with capitalization $1,000,000, in 40,000 shares of $25 par. W. F. Fitzgerald, president; John Brooks, secretary and treasurer. Mining property, about midway between Arnold and Phœnix mines, in Keweenaw Co., Mich. Mine opened 1853; has never been a producer; has one shaft 300′ on the Arnold ashbed. Last exploratory work was done in 1900; about $125,000 has been expended on the property.

**HUMBUG MINING CO. UTAH.**

At Eureka, Juab Co., Utah; J. W. Roundy, superintendent. Has gold, silver and copper ores, developed by shaft; steam power; employs about 50 men.

**HUMMER GROUP. CALIFORNIA.**

Owned by Mischler & Rollins, Callahans, Siskiyou Co., Cal. Ore occurs as irregular bodies of chalcopyrite, disseminated in pyrrhotite, and carrying a little nickel.

**HUNT MINING & MILLING CO. IDAHO.**

Office: 8 India St., Boston, Mass. Mine office: Weiser, Washington Co., Idaho. Mr. D. F. Hunt writes that the company is doing no business.

**HUNTER MINING CO.** **WASHINGTON.**

James E. Blackwell, president. Address not secured. Lands, in Washington, are said to have ore vein of 3′ to 9′, assaying $32 per ton in gold, silver and copper, and slightly developed by shafts, tunnels and open cut.

**HURON MINING CO.** **WASHINGTON.**

At Darrington, Snohomish Co., Wash. J. E. Sawyer, superintendent. Was developing by tunnel, with small force, at last accounts.

**HUSSLEMAN & SHAW GROUP.** **CALIFORNIA.**

A group of 31 claims, in the Moonlight Creek district, Lights Cañon, Plumas Co., Cal. Was developing by tunnel at last accounts.

**HUSTON MINE.** **ONTARIO.**

Property, 1,400 acres, located at Montgomery, 15 miles north of Thessalon, Algoma, Ont. Owned by J. J. Case, Dollar Bay, Mich., and 16 other equal shareholders. Vein, 60′ between walls, with 18′ of payable ore, traced 3,000′. Pay streak assays 8% copper. Vein stands up as a 40′ bluff, and can best be developed by tunnels. Is a concentrating ore, with quartz gangue, and can be concentrated to 20% or better. Lacks rail transportation and now idle.

**HYCO MINE.** **VIRGINIA.**

An old and idle property, located north of Virgilina, Va.

**IBARRA HERMANOS.** **SPAIN.**

Offices: Sevilla, Spain. Mines, at Cortegana, Huelva, Spain. No returns secured.

**ICONOCLAST CONSOLIDATED MINES CO.** **WASHINGTON.**

Office: 412 Berlin Bldg., Tacoma, Wash. Mine office: Keller, Ferry Co., Wash. Succeeded the Alliance Copper Mining Co. and Iconoclast Gold & Copper Mining Co. Employs 6 men. Organized 1902, under laws of Washington, with capitalization $2,500,000, shares $1 par. J. R. Turner, president; H. S. Owen, vice-president; C. E. Peterson, secretary; Donald McPherson, treasurer; preceding officers, J. B. Cromwell and C. E. Griffin, directors; Alex. McMasters, superintendent; Robt. Young, mining engineer. Lands, 7 claims, area 115 acres, showing 3 contact veins, one stated by company to be 150′ wide, carrying 5% copper, $2 gold and 2 oz. silver per ton. Ore is chalcopyrite. Deepest shaft, 325′; 3 tunnels, with aggregate length of 514′. Gasoline power. Company will continue development work and install new machinery in 1903.

**IDAHO CONSOLIDATED COPPER MINES CO.** **IDAHO.**

Office: 17 Park Row, New York. Mine office: Decorah, Washington Co., Idaho. Organized 1899, under laws of West Virginia, with capitalization $1,000,000, shares $10 par. C. F. Hathaway, president; J. M. Archer, secretary. No returns secured.

**IDAHO COPPER MINING & MILLING CO.** **IDAHO.**

Office: 502 Andrus Bldg., Minneapolis, Minn. Chas. G. Carruthers, general manager, Colville, Wash. Lands, 160 acres on the Salmon River, Idaho Co., Idaho. Surface assays show 30% to 40% copper.

**IDAHO MILLING CO.** **IDAHO.**

Supposed to have gold-copper claims in the vicinity of Doniphan, Blaine Co., Idaho, but letter to that address returned unclaimed, November, 1902.

**IKONOMOFF CESSION.** **BULGARIA.**

M. Dimitri Ikonomoff, Hotel Boulevard, Sofia, Bulgaria, holds a cession from the principality for mineral lands at Kara-Baîr, Bourgos, Bulgaria. Property is in exploratory and development stage; no returns secured.

**ILLINOIS COPPER MINING CO.** **WYOMING.**

Office: 862 Monadnock Blk., Chicago, Ill. Mine office: Encampment, Carbon Co., Wyo. Organized 1899, under laws of Wyoming, with capitalization $1,000,000, shares $1 par. Geo. H. Miller, president and general manager; Geo. Ingersoll, vice-president; N. V. S. Mallory, secretary and treasurer; preceding officers, Thos. A. Smith and Schuyler C. French, directors; Thos. R. Smith, superintendent. Property, 9 claims, area 185 acres, in the Upper Platte district of Carbon Co., Wyo., showing 3 contact veins; principal vein 18′ wide, 50′ deep and 4,500′ long, carrying chalcocite in quartz gangue and assaying 14% to 27% copper, $4 gold and 20 oz. silver per ton. Three shafts, deepest 70′. Company purposes continuing underground development and adding machinery equipment in 1903.

**ILLINOIS GOLD & COPPER MINING CO.** **MEXICO.**

Office and mines: Panuco, Coahuila, Mexico. W. E. Ankrum, manager. Operates Las Caballos mine, producing copper, gold and silver ores. Was working small force at last accounts.

**IMPERIAL COPPER CO.** **ARIZONA.**

Office: 6 Wall St., New York. Mine office: Wickenburg, Maricopa Co., Ariz. Employs 6 men. Organized 1901, under laws of South Dakota, with capitalization $1,500,000, half issued, shares $1 par. Edw. C. Mohnike, president and general manager; Jas. H. Childs, vice-president; Edwin W. Salmon, secretary and treasurer; Albert J. Mohnike, superintendent. Lands, 3 unpatented claims, area 62 acres. Company is locating 12 additional claims, in the Wickenburg district of Maricopa Co. Six ore bodies are being developed; these having given assays of 25% copper, $3.40 gold and 30 oz. silver per ton, from carbonate and sulphide ores. Work just begun; 4 shallow shafts started. Property is 14 miles from railroad. Company will continue development work in 1903 and ship ore by wagons to smelter at Wickenburg.

**IMPERIAL COPPER CO.** **ONTARIO.**

Organized at Duluth, Minnesota, in November, 1899, to exploit bornite ore deposits in Parry Sound district of Ontario. Letter to company addressed Duluth returned unclaimed, October, 1902.

**IMPERIAL COPPER MINING CO,** **CALIFORNIA.**

Owns the Painter mine, near Pollasky, Fresno Co., Cal. Vein, 4′ to 7′ wide, showing oxidized ores averaging 15% copper, in gangue of talcose schist traversing diabase and amphibolite schist. Three shafts, deepest 110′; idle at last accounts.

**IMPERIAL COPPER & GOLD MINING CO.** **WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. M. F. Whalen, superintendent. Was working a small force at close of 1902.

**IMPERIAL MINING CO.** **UTAH.**

Office: 205 La Salle St., Chicago, Ills. Mine office: Frisco, Beaver Co., Utah. Capitalization $6,000,000, shares $10 par. A. B. Lewis, president and manager; G. H. Haynes, secretary and treasurer. Lands, about 400 acres, in the neighborhood of the Horn Silver mine, in the Frisco district of Beaver Co. The Imperial is a neighbor of the Majestic property, and is regarded as promising. No returns secured.

**IMPERIAL MINING CO.** **WASHINGTON.**

James E. Dupree, president, Marysville, Wash; M. Swinnerton, superintendent. Lands, 11 claims, near Silverton, Snohomish Co., Wash., carrying gold, silver, copper and lead, in a contact vein between diorite and conglomerate. Was developing, at last accounts.

**IMPERIAL PAINT & COPPER CO.** **CALIFORNIA.**

Mine office: Spenceville, Nevada Co., Cal. Otto Woehler, superintendent. Has steam power; mine developed open-cast.

**IMPERIAL-MONTANA COPPER MINING, SMELTING & WATER POWER CO.** **MONTANA.**

Offices: 271 Broadway, New York, and Helena, Mont. Mine office: Blackfoot, Teton Co., Mont. Organized 1901, under laws of Arizona, with capitalization $10,000,000, shares $10 par. J. H. Calderhead, vice-president; Oliver M. Holmes, treasurer; J. B. Holmes, superintendent. Lands, 9 claims, area about 180 acres, on which more or less development work has been done. Company in financial straits at last accounts.

**INCA MINING CO.** **IDAHO.**

Mine office: Cuprum, Washington Co., Idaho. M. O. Reed, superintendent. Opened by shaft and tunnels. Ores carry copper and silver values.

**INDEPENDENT MINE.** **MONTANA.**

An idle property on the Tobacco Plains, near Kalispell, Montana. Vein said to be 25′ wide, showing 8% copper, and $4 to $10 gold and silver per ton.

**INDEPENDENT MINING CO.** **WASHINGTON.**

Mine office: Baring, King Co., Wash. Benj. Evans, superintendent. Was developing a copper ore body by tunnel at last accounts.

**INDEX MINING CO.** **WASHINGTON.**

Lot Wilbur, president and general manager, Snohomish, Wash. Property, 5 claims, lying 2 miles southeast of Index and south of Skykomish river, showing 3 veins. One vein developed, this averaging 3′, with pay streak on either wall. Ores, bornite and chalcocite, giving increased values at depth. No returns secured; probably idle.

**INDEX-BORNITE COPPER MINING CO.** **WASHINGTON.**

Mining property near Index, Snohomish Co., Wash. A. M. Watt, superintendent. Vein, 2′ wide, carrying bornite assaying 16% to 50% copper, with 6 to 8 oz. silver per ton.

**INDEX-HORSESHOE COPPER MINE. WASHINGTON.**

Address: care of F. Danel, 217 Columbia St., Seattle, Wash. Property supposed to be near Index, Snohomish Co., Wash. No returns secured.

**INDEX-INDEPENDENT MINING CO. WASHINGTON.**

Benj. Evans, superintendent, Index, Snohomish Co., Wash. Property, three claims, five miles southeast of Index. Has about 1,000′ of development work. Vein nearly vertical, traversing granite, carrying chalcopyrite, chalcocite and bornite, with quartz gangue. One carload of ore shipped assayed $98.98 per ton.

**INDEX-PEACOCK COPPER MINES. WASHINGTON.**

Address: care of F. Danel, 217 Columbia St., Seattle, Wash. Property probably in Index district of Washington. No returns secured.

**INDIAN QUEEN MINE. MONTANA.**

At Dillon, Beaverhead Co., Mont. Richard Dawe, superintendent. Copper ore body being developed by tunnel; has steam plant; employs about 25 men.

**INDIANA MINE. MICHIGAN.**

A tract of 1,280 acres in Sections 21, 27 and 28, Town 51 North, Range 37 West, Ontonagon Co., Mich. Owners spent $200,000, circa 1862-65; has two shafts, 180′ deep each; idle many years.

**INDIANA COPPER CO. WYOMING.**

A newly incorporated company, holding 6 claims near the Rambler mine, Wyo. No returns secured.

**INDIANA-SONORA COPPER & MINING CO. MEXICO.**

An Indiana corporation, with valuable claims near La Cananea, Sonora, Mexico. Said to have been sold in 1902 to Phelps, Dodge & Co., of 99 John St., New York. Ore carries good values in copper, gold and silver; mine developed by shafts and tunnels; equipped with steam power and smelter; employed about 150 men, at last accounts.

**INDIANAPOLIS COPPER MINING CO. WYOMING.**

Lands, 14 claims, area about 280 acres, 6 miles southwest of Riverside, Carbon Co., Wyo. Was installing steam plant late in 1902.

**INEZ GOLD & SILVER MINING CO. COLORADO.**

Supposed to have claims in the vicinity of Crystal, Gunnison Co., Colo.; letter to that address returned unclaimed, November, 1902.

**COMPANIA INGLESA DE MINAS. CHILE.**

This is given as the title of an English company operating at Puquios, Copiapo, Atacama, Chile. No returns secured.

**COMPANIA MINERA DE INGUARAN. MEXICO.**

Office: Paris, France. Mine office: Ario, Michoacan, Mexico. J. L. Phillips, director. Company is a close corporation and gives out no information. Control is understood to be held by the Rothschilds. Price paid for property, undeveloped, was $1,500,000 Mexican. Property is in the Tacambara district, near the river of the same name, state of Michoacan, Mexico, about 75 kilometres from the Mexican National R. R. Country rock of this district is granite, in several states of alteration, capped by a silicious limestone, ranging 200′ to 300′ in thickness. Ores of the district range 1.5% to 65% copper, with gold from a trace up to 1 oz. and silver 2 to 100 oz. per ton. Ores are sulphides, mainly chalcocite, associated with a little bornite and chalcopyrite. Estimates of ore values vary greatly, but as near as can be learned the property has a large body of medium-grade concentrating ore, disseminated in granitic rock. Mine has a 330′ shaft and 2,300′ tunnel, and was working 300 men late in 1902. Is preparing to develop a water power adjacent, and to erect a concentrating plant and 1,000-ton smelter. Company is building a railroad from the mine to Zihuatanejo, on the Pacific coast. It is expected that this mine will become one of the world's largest copper producers eventually, but the output is not likely to be large during 1903, owing to the great amount of development work remaining to be done.

**INTERCOLONIAL COPPER CO. NEW BRUNSWICK.**

Office: 702 Banigan Bldg., Providence, R. I. Mine office: Dorchester, N. B. Employs 40 men. Organized 1899, under laws of Arizona, with capitalization $2,500,000, shares $10 par, non-assessable. Darius L. Goff, president; Henry A. Stearns, vice-president; J. W. Phillips, treasurer; T. J. Edwards, secretary; directors are preceding officers, Walter Callender, Albert E. Farwell, Walter S. Ballou, John A. Paine and Moses G. Leonard. Alan N. Chapman, general superintendent; L. S. Griswold, mining captain; Henry Carmichael, of Boston, consulting mining engineer. Lands, 250 acres owned in fee, and 1,100 acres held under lease from the crown. Carbonate and sulphide ores are found in a blanket vein, and return 3% to 4% copper, or about 1 per cent. better than predicted. Has three shafts, 40′, 75′ and 150′, also drainage tunnel of 1,500′. Mine openings aggregate 8,000′. Steam and electric power used; has boilers, hoisting engine, air compressor, power drills, etc.

Concentrator has 200 tons daily capacity, equipped with 2 boilers, 4 engines, Buchanan crusher, rolls, etc. There are 15 tubular roasting furnaces, 6 large leaching vats of 300 tons capacity each, 2 Holtzer-Cabot dynamos of 50 kilowatts each. Electrolytic plant has 550 lead cathodes and 550 lead annodes 22x33″, giving a plating surface of 5,000 square feet, for deposition of electrolytic copper, also large tanks for precipitation of cuprous leachings on scrap iron as cement copper. Intercolonial Railroad is 2½ miles distant from mine. New work contemplated for 1903 includes additional mine openings, installation of electric drilling plant and increase of electrolytic plant. Production of refined copper for 1902 was about 1,000 tons.

**INTERNATIONAL COPPER CO. COLOMBIA.**

Office: 71 Broadway, New York. Organized, October, 1900, under Arizona laws, with capitalization $1,000,000, shares $1 par. Lands, 2,300 acres near Natagamia, Tolima, Colombia. Property said to carry good showing in copper, but at present is in prospecting stage only.

**INTERNATIONAL COPPER & GOLD CO.** **COLORADO, MONTANA & MEXICO.**

Office: 1122–135 Adams St., Chicago, Ill. Employs 60 men. Organized 1899, under laws of Arizona, with capitalization $3,000,000, shares $1 par. Albert G. Beaunisne, president; Frank De Golyer, vice-president; A. B. Ballou, secretary and treasurer; W. C. Hermbuecher, general manager; Gad Freeman, general superintendent; Victorio Escajeda, and Miguel Vildosola, mine and mill superintendents; Chas. B. Gibson, mining engineer. Lands, 149 claims, area about 400 acres, in Routt Co., Colo., Madison and Missoula Counties, Mont., and states of Sonora and Sinaloa, Mexico. Has shaft of 280′ in Montana, and shaft of 60′ in Colorado. Ores are sulphide in Colorado, carbonate in Montana, and carbonate and oxide in Mexico.

Company owns La Josefita group of 50 claims, in Sonora, near the Sinaloa line. Ore body said to be 80′ wide, from which assays of 25% to 28% have been secured. Surface showing said to be good. Plan of operation on this group contemplated by company is quarrying. La Australia group of 20 claims is near El Fuerte, Sinaloa, and is opened by a 70′ two-compartment shaft showing a 1′ pay-streak of bonanza ore, assaying 15% copper and 1,212 oz. silver per ton. La Sorteo group, 7 miles from San Bernardo, has 10 claims, with 30′ vein and 150′ tunnel, showing good assay values in gold, silver and copper. El Negro group of 14 claims carries gold and silver. The Piedregal group of 15 claims is a little east of El Negro. La Higuera group of 8 claims, in Sonora, shows a 16″ pay-streak, carrying mainly silver values, in a 50′ vein. El Nino group, 30 miles southwest of San Bernardo, has 10 claims, showing good assay values in gold, silver and lead. The Zacatecas group of 10 claims carries gold.

Title to the Montana property is now the Montana Copper & Gold Mining Co., stock of which is controlled by the International Copper & Gold Co. The Escalanta group, in Routt Co., Colo., is undeveloped.

**INTERNATIONAL COPPER MINING & MILLING CO.** **WYOMING.**

Address: care of F. M. Dunn, Minneapolis, Minn. Mine office: Encampment, Carbon Co., Wyo. Was prospecting with small force at last accounts.

**INTERNATIONAL GOLD & COPPER MINING CO.** **IDAHO.**

Incorporated September, 1902, with capitalization $500,000, to operate the Lost Horse mine, on Pocatello Creek, Idaho. No returns.

**INTERNATIONAL GOLD & COPPER MINING CO.**

Office: 62 Commercial Blk., Salt Lake City, Utah. No returns secured.

**INTERNATIONAL MINING & REFINING CO.** **CHILE.**

Owns and operates a group of old mines at Chañaral, Atacama, Chile. Is also opening mines in the Huantajaya district of Chile. No returns secured.

**INTERNATIONAL NICKEL CO.**

Office: 24 Broadway, New York. Commonly known as the Nickel Trust. Holdings include controlling stock interests in the Canadian Copper Co.; Orford Copper Co.; Vermillion Mng. Co.; The American Nickel Works; Nickel Corporation, Ltd., and Societe Miniere Caledonienne. Capitalized at

$24,000,000, half 6% non-cumulative preferred and half common stock. Has authorized $12,000,000 of 5% 30-year gold bonds. Produces a considerable amount of copper as a by-product, mainly from the Sudbury mines of the Canadian Copper Co.

**IOWA & NEW MEXICO MINING CO.** **NEW MEXICO.**

Is developing claims at Scheherville, N. M. No returns secured.

**IRIGOYEN HERMANOS.** **MEXICO.**

Located at Huetamo, Michoacan, Mexico. No returns secured.

**IRON CROWN GROUP.** **ALASKA.**

Located at Copper Harbor, Prince of Wales Island, Alaska, and said to have a good showing of ore, but no returns secured.

**IRON DYKE MINE.** **OREGON.**

At Carson, Union Co., Ore. Frank E. Pearce, superintendent. Property owned by residents of Erie, Pa. Was developing a copper ore body by tunnel, at last accounts.

**IRON HEAD & REPUBLIC MINES.** **NEW MEXICO.**

At Fierro, Grant Co., N. M. Said to be equipped with steam power and to employ 50 men.

**IRON KING MINE.** **ARIZONA.**

Near Jerome, Yavapai Co., Ariz. Senator W. A. Clark, owner; Jos. L. Giroux, manager. No returns secured.

**IRON MASK MINE.** **BRITISH COLUMBIA.**

Mine office: Rossland, B. C. Secures a limited amount of copper as a by-product from gold and silver ores.

**IRON MOUNTAIN COPPER CO.** **UTAH.**

Said to be developing veins carrying copper, lead, gold and silver, 18 miles from Lund, Utah. Duncan J. Frew, superintendent at last accounts; no returns secured.

**ISABEL MINE.** **MEXICO.**

At Saric, Sonora, Mexico. Owned by Jesus M. Celaya y Ca. Said to be opened by tunnels and to employ about 50 men.

**ISABEL COPPER MINING CO.** **WYOMING.**

Office: Fremont, Neb. Mine office: Encampment, Carbon Co., Wyo. C. H. Brunner, president; J. H. Knowles, secretary; D. S. Baker, superintendent. Was doing assessment work, November, 1902.

**ISHPEMING & BISBEE DEVELOPMENT CO., LTD.** **ARIZONA.**

Office: Ishpeming, Mich. Lands, near Bisbee, Cochise Co., Ariz. Wm. Wills, superintendent. Organized late in 1902 to develop promising copper claims in Cochise Co., Arizona.

**ISLAND CITY COPPER MINING CO.** **WYOMING.**

Office: Eaton Rapids, Mich. Mine office: Saratoga, Carbon Co., Wyo. L. F. Hosler, superintendent. Was developing in fall of 1902.

**ISLAND MOUNTAIN CONSOLIDATED COPPER CO.** **CALIFORNIA.**

A slightly developed property of some promise, in Trinity Co., California, near the Mendocino county line. Lands, 7 claims, with a 490′ tunnel and several open cuts. Outcrop traced for 800′ and vein is 130′ wide in places. Vein is capped with large boulders carrying copper and iron sulphides. No returns secured.

**ISLE ROYALE COPPER CO.** **MICHIGAN.**

Office: 199 Washington St., Boston, Mass. Mine office: Houghton, Houghton Co., Michigan. A considerable producer, now working under check. Present company is a consolidation of the Isle Royale Consolidated Mining Co. and the Miners' Copper Co., effected March, 1899, under New Jersey laws, with capitalization $3,750,000, in 150,000 shares, par $25. Annual meeting, first Wednesday in April, at Jersey City, N. J. A. S. Bigelow, president; W. J. Ladd, secretary and treasurer; A. S. Bigelow, W. J. Ladd, C. H. Bissell, W. A. S. Chrimes, Edgar Buffum, directors; R. M. Edwards, assistant superintendent and in immediate charge; H. D. Haddock, clerk; Edward Warmington, mining captain; Jas. G. Glanville, mill superintendent; Jas. E. Richards, master mechanic.

The Isle Royale Consolidated and the Miners' company each started business with $1,000,000 cash and clear titles to lands, giving $2,000,000 cash for the development and equipment of the present consolidation. The Isle Royale began 1901 with a balance of $832,742.21, and ended with a balance of $406,415.20. Expenses for 1901; $402,556.54 for operation, $305,039.69 for construction, a total of $707,596.23, with receipts of $281,269.22, from production of copper, interest, etc. The Isle Royale owns $50,000 stock of the Lake Superior Smelting Co. For 1901 the rock hoisted was 201,951 tons; rock stamped, 185,175 tons; production of mineral, 3,172,509 lbs.; production of refined copper, 2,171,955 lbs., showing a yield of 68% ingot copper from the mineral. Cost of rock stamped was $1.86 per ton, of which $1.20 was for mining and 25 cents for stamping; average force employed, 478 men.

The company's real estate, bought for $2,000,000, comprises 3,240 acres of mineral lands and an 80-acre millsite. Property includes the old Isle Royale, Grand Portage and Huron mines, the Dodge and Frue prospects and a large area of undeveloped lands. Company also holds a long-term option on the mineral rights of the Montezuma tract, about 250 acres lying next west. The Isle Royale has two miles north and south, giving nearly 2½ miles on the strike of the cupriferous lodes, which is approximately N.32°E., with an average dip of 56°. The mineral lands include all of Sections 1, 2 and 11 and part of Sections 3, 9, 10 and 15, in Town 54 North, Range 34 West; also 160 acres in 6–54–33; 40 acres in 31–55–33 and 160 acres in 36–55–34. These lands are bounded on the north by the Dacotah and Shelden & Columbian; on the east by the sandstone; on the south by undeveloped mineral lands and on the west by the Atlantic and Naumkeag.

The three old mines included in the present Isle Royale tract made 24,226 tons, 590 lbs. refined copper, of which the Huron furnished 17,883 tons, 225 lbs., the Isle Royale 4,602 tons, 71 lbs., and the Grand Portage 1,471 tons, 294 lbs. These products were secured under primitive conditions at a loss of about $2,500,000. The old Isle Royale mine was opened in 1853, the Grand Portage in the same year and the Huron in 1855. The history of all these is given in detail in the 1902 edition of this work. The Frue and Dodge tracts, lying south of the Huron, are merely explorations.

The Isle Royale has three amygdaloid beds, parallel in strike and dip, of which two have been extensively opened. These are the Isle Royale and Portage, the latter lying approximately 200′ west of the former. The Isle Royale shafts are on the lode of that name, but the Portage bed is opened on many levels by crosscuts, both lodes being mined through the shafts on the Isle Royale bed. To the eastward of the amygdaloids is the "Mabbs Vein." This lies near the Eastern sandstone, is 4′ to 7′ wide and rich in mass and barrel copper, but deficient in stamp rock. The Mabbs was opened to a depth of about 250′ by John and Austin Mabbs, who had the mine on tribute many years ago, but has not been reopened by the present management. There are also unidentified and unexplored copper-bearing amygdaloids lying west of the Portage, some of which carry arsenical ores of copper as well as native metal. A search for the northern extension of the Baltic lode was begun in August, 1902, on the southern part of the Isle Royale lands, by diamond drill borings.

The work of reopening the old Isle Royale mine was begun August, 1897. The present No. 1 shaft is old No. 1, straightened, deepened and enlarged to 3-compartment size. It is near the northern edge of the company's lands and is now bottomed in the hanging wall, 53′ below the 16th level. The Portage lode, 150′ to 220′ to the westward, has been reached by five crosscuts, on the 11th to 15th levels, and about two miles of drifts have been opened thereon. It is thought to be slightly richer than the Isle Royale lode, though both beds are unusually similar in characteristics.

No. 2 shaft, with 3 compartments, is 2,280′ southward of No. 1, and is 64′ below the 16th level. Both shafts are in virgin ground below the 10th level. The mine has about eight miles of new underground openings, in addition to about three miles of old openings, in the old Isle Royale and Grand Portage mines, and about five miles in the Huron, mostly stoped out. No work has been done in the Huron, which has 10 old shafts, though sites for two shafts have been selected on this tract. The bed runs as wide as 80′ in certain levels of No. 10 Huron shaft and it is supposed the lode has been lost in the bottom levels of the southern end of the Huron. Both of the new Isle Royale shafts are straight, well timbered and have skip tracks laid with 45-lb. rails. The two new shafts have greater capacity than the 28 old shafts opened in the three old mines. Masonry dams have been built at various points to hold back the waters from old openings.

The two new shafts have duplicate equipments. The combination shaft and rock houses are 44x60′ on the ground and 90′ high, fitted with the heaviest crushers ever built, made by the Portage Lake Foundry & Machine Works, these having 18x24″ and 13x20″ openings. There is a coal trestle with 3,000 tons storage capacity and two-stage compound 35-drill Nordberg air compressors at each shaft. The engine houses are 50x90′, of steel, on stone foundations. The drums are 18′ 6″ in diameter, with lathe-turned grooves for 6,000′ of 1½″ steel cable, built to hoist six-ton skips from a depth of 6,000′.

Boiler houses are 44x72′, with coal-storage additions 16x72′, each housing 3 Burt boilers, horizontal type, with 84″ shells, rated at 150 h. p. The machine shop is 40x60′, steel frame on stone foundations, with full equipment of tools required for heavy mining work. A dam to impound feed-water for the boilers is 300x500′ in area by 6′ deep.

The mine has about 100 good dwellings and the village of Hurontown stands on the company's lands, with Houghton distant less than a mile. The growth of the latter town renders it probable that the company can sell considerable land eventually, for building lots.

The Isle Royale Railroad, owned by the company, has 4 miles of main line, with easy grades. Equipment includes one 35-ton and one 55-ton locomotive and 40 steel rock-cars of 40 tons capacity each, fitted with air brakes. The railroad touches all principal points at the mine and mill.

The millsite is at the mouth of the Pilgrim river, with nearly a mile frontage on Portage Lake. The mill is 134x210′, of steel frame on stone foundation, having three Nordberg stamps with circular mortars and 3/8″ screen openings, capable of treating about 450 tons each, daily. The jigs are all of the Parnall-Krause design, made by the Portage Lake Foundry & Machine Works. Each stamp has 32-ton mortars resting on anvil blocks bedded on platforms of oak timbers 20′ square and 3′ thick, each timber being 14x24″ by 20′. Underneath each platform is a caisson reaching to bedrock, made of 5/16″ boiler steel, 74′ long, and 12′ in diameter until near the top, where there is a bell-shaped flare 20′ in diameter, to support the oak platforms under the anvil blocks. The caissons are filled with concrete, as is the space between them. The rock bins at the mill hold 2,000 tons each. There are 72 rough jigs and 36 finisher jigs, and slime tables with one Bartlett and two Wilfley concentrators to treat the slimes from the circular tables. There is a complete machine shop on the second floor of the mill, an engine of 750 h. p. running the mill and shop. There are 4 boilers of 250 h. p. each, in a steel boiler house 46x72′ at the rear of the mill.

Water is furnished the mill by a Nordberg-Corliss pump of 16,000,000 gallons daily capacity. The pump was especially designed to handle muddy water and has a triple discharge into a 30″ steel-riveted water main, which runs 2,200′ from pumphouse to mill, the former building being located some distance from the mill to avoid stamp-sand clogging the intake. A separate boiler house has been built for the pump, this containing three 100-h. p. boilers. A large coal trestle has been erected at the rear of the pumphouse boiler rooms, and a small creek has been dammed near the mill to supply water for the boilers.

There is a wharf 32x600′ at the millsite, with deep water alongside, fitted with appliances for unloading coal cargoes and for the receipt of general freight and dispatch of mineral from the mills, the mineral being taken by water across Portage Lake to the smelters at Dollar Bay. Two stamps were started in May and the third in July, 1901, but the third stamp was soon stopped. In June, 1902, the production of mineral was 340 tons, of which 52 tons, or about 15%, was heavy copper. This amount of mineral was equal to about 235 tons of refined copper, and was secured at a cost of about $1.25 per ton of rock stamped, or ten cents per pound of copper produced. No. 1 shaft and No. 2 head at the mill were closed down July 1, 1902. Forces were successively reduced to about 200 men in December, 1902, with 17 power drills and 3 drifts running. About 450 tons is being stamped daily, returning 1% mineral, or about 14 lbs. copper per ton, giving a production at the rate of about 1,800,000 lbs. annually. In 1901 the rock stamped returned 11¾ lbs. copper per ton, or a percentage of 0.5785—the lowest in the Lake district, verifying the estimate of 0.65 per cent. made in the 1900 edition of this work, before the starting of the mill.

The company can scarcely be earning expenses with a single stamp, but the monthly deficiency is probably not large. The mine has always been notable for its silver, and part of the Isle Royale mineral smelted at Dollar Bay is cast into anodes and refined electrolytically at Chicago, thus saving the considerable percentage of silver contained.

**ISLE ROYALE LAND CORPORATION, LTD. MICHIGAN.**

Offices: 24, North John St., Liverpool, Eng. R. Young, chairman; J. Tibbs, secretary; R. R. Goodell, agent, Houghton, Mich. Name changed from Wendigo Copper Company, Ltd., to present title, July, 1901. Capital, nominal, £225,000, in £5 shares. Lands comprise 83,720 acres on Isle Royale, Lake Superior, Mich., mainly copper bearing and located on the northern fold of the Keweenawan synclinal.

**IVANPAH SMELTING CO. CALIFORNIA.**

Alleged to be opening a copper mine near Blake, San Bernardino Co., Cal. Letter to company returned unclaimed, from both Blake and Manvel, in November, 1902.

**JACKSON & BONDURANT. ARIZONA.**

Supposed to be working a copper prospect near Quartzite, Yuma Co., Ariz. No returns secured.

**JACK TAR COPPER CO. ARIZONA.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Property said to be worthless. See Excelsior Copper Co.

**JALISCO COPPER MINING CO. ARIZONA.**

Office: 135 S. Broadway, Los Angeles, Cal. Mine office: Nogales, Santa Cruz Co., Ariz. Organized under laws of Arizona, with capitalization $1,000,000, shares $1 par. A. R. Noon, president; W. J. Stevens, secretary. Lands, 8 claims, area 160 acres, near Oro Blanco, Pima Co., Ariz. Company advertises that it will send prospectus and full particulars on application, but furnished no returns for this book, although asked to do so.

**JARILLA COPPER CO. NEW MEXICO.**

Mine office: Alamogordo, N. M. B. F. Schermerhorn, general manager. Was sinking and drifting on the Three Bears claim, at last accounts. No returns secured.

**JASPER MOUNTAIN COPPER CO. WYOMING.**

Mine office: Douglass, Wyo. H. R. Mewis, superintendent. Was employing a small force in development work, at last accounts.

**JEFFERSON COPPER CO.**

Address: probably care of Wm. F. Wernse & Co., Bond & Stock Co., 421 Olive St., St. Louis, Mo. Company said never to have owned a foot of ground. See Excelsior Copper Co.

**JEFFS LAND CO.** **MICHIGAN.**

Address: Rockland, Ontonagon Co., Mich. Owns 800 acres of mineral land, north and west of Rockland, on which a little exploring work was done 1899–1900.

**JELM TOWNSITE & MINING CO.** **WYOMING.**

Office: Kasota Blk., Minneapolis, Minn. Mine office: Jelm, Wyo. No returns secured.

**JENNY DELL MINING CO.** **MONTANA.**

Office and mine: 47 East Broadway, Butte, Silver Bow Co., Mont. M. V. Conroy, president; L. J. Matlock, vice-president; Jefferson Dee, secretary and treasurer. Property is the Jenny Dell and October mines, just west of the Eveline, in Butte. No returns secured.

**JEROME COPPER CO.** **ARIZONA.**

Dead. See Cleopatra.

**JEROME SILVER-COPPER MINES CORPORATION.** **ARIZONA.**

Address· care of C. D. Smith & Co., 25 Broad St., New York. Lands are somewhere in or near the Verde copper belt of Yavapai Co., Arizona.

**JEROME CANON COPPER CO.** **ARIZONA.**

Office: 106½ So. Broadway, Los Angeles, Cal. Mine office: Jerome, Yavapai Co., Ariz. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par. J. W. Tibbot, president; J. A. Patton, vice-president; G. B. Tibbot, secretary; J. S. Smith, superintendent. Lands, 16 claims, in Yavapai Co., including the Copper Glance mine. Has steam power. Vein, 2′ wide on first level and 7′ wide in north drift, showing ore body said to assay 28% copper, $110 gold and 60 oz. silver per ton. Company is composed of men of good standing.

**JESSIE BELLE MINING, MILLING & SMELTING CO.** **CALIFORNIA.**

Office: 302 Lankershim Bldg., Los Angeles, Cal. Employs 5 men. Organized 1902, under laws of Arizona, with capitalization $1,500,000, shares $1 par. W. H. Sallada, president; M. A. Proper, vice-president; W. T. Carter, secretary; W. W. Wilson, treasurer. Lands, 3 patented claims, area 40 acres, in Madison Co., Cal., showing 4 fissure veins carrying a variety of copper ores. Company estimates width of ledges at 800′ and average value of ore at 30% copper, $15 gold and 8 oz. silver per ton.

**JESUS MARIA MINES CO.** **MEXICO.**

Mine office: Parral, Chihuahua, Mexico. P. L. Fearn, manager. Ores, give gold, silver and copper values; mines opened by shafts and equipped with steam power; employs about 100 men.

**JIMULCO MINING CO.** **MEXICO.**

Office: San Antonio, Texas. Mine office: Jimulco, Coahuila, Mexico. Otto Wahrmund, president; M. J. Welch, first vice-president; O. S. Newell, second vice-president; S. G. Newton, secretary; John J. Stevens, treasurer.

Operates the Guadalupe, Casita and Alferis mines, producing copper, gold and silver. Is shipping 40 to 50 tons of rich ore daily to the smelters at Aguascalientes, this ore running 20% or better in copper, with small gold and silver values. Has 130′ shaft and 300′ tunnel. Is building a tramway from the mine to the Mexican Central Ry., and making sundry surface improvements. Has gasoline power and employs about 200 men. Property is decidedly promising.

**JOHANNESBURG CONSOLIDATED INVESTMENT CORPORATION. GERMAN SOUTHWEST AFRICA.**

Office: Johannesburg, Transvaal, So. Africa. Capitalized at 3,000,000 marks. Has leased the mineral rights to 10,752,000 acres of land in German Southwest Africa, from the German Colonial Company.

**JOHN D. COPPER MINING CO. WASHINGTON.**

Sold to Ethel Consolidated Mines Company.

**JOHN DIAS MINE. CALIFORNIA.**

Property in Section 12, Town 6 South, Range 16 East., Mariposa Co., Cal. Opened by shallow shaft on 3′ vein in schistose diabase, carrying cuprite, azurite chrysocolla and chalcopyrite. Ore said to assay $40 per ton in copper and gold.

**JOHNSON MINE. NORTH CAROLINA.**

Near High Point, N. C. Being opened; had a 30′ shaft in 4′ vein of sulphide ore, December, 1902.

**JOSEPHINE MINE.**

Address: care of Bevis Bros., Spokane, Wash. Located in the Metalline camp, Washington. Shaft said to show an 11′ vein at depth of 50′. No returns secured.

**JOSEPHINE & CONNECTICUT MINES. ARIZONA.**

At Patagonia, Santa Cruz Co., Ariz. Owned by R. K. Richardson and Wm. T. Powers. Ores carry copper, silver and gold values. Opened by shaft; steam power; employ about 25 men.

**LE JOYA MINE. SPAIN.**

Address: care of Don Manuel Vasquez Lopez, Huelva, Spain. Property at El Cerro, Huelva, Spain. Area, 53 hectares; idle at last accounts.

**JULIA DEANE MINING CO. UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. David Clay, manager. Ores carry gold and copper. Said to be developing by tunnel, with steam power.

**JUPITER MINING CO.**

Office: Tomah, Wis. Dr. C. E. Quigg, president. No returns secured.

**JURA-TRIAS COPPER CO. NEW MEXICO.**

Mine office: Cuba, Bernalillo Co., N. M. Thos. J. Curran, president; Geo. W. Stubbs, secretary; Wm. Jenks, manager. Opened by tunnels. Equipped with steam power. Has 25-ton smelter, which has proven inadequate, and management contemplates enlarging it. Company also operates a coal mine.

**JUSTICE MINING CO. COLORADO.**

Has gold-silver-copper claims at Central City, Gilpin Co., Colo. Letter to company returned November, 1902, with notation that the present manager is unknown.

**KAFVELTORPS KOPPERVERK. SWEDEN.**

In Orebro Län, Sweden. A small producer; output for 1901 was 112,590 kgs. of matte, averaging 72% copper, and 16,423 kgs. of refined copper, also considerable values in lead and silver, secured as by-products.

**KALAMAZOO COPPER MINING CO. COLORADO.**

Eastern office: Kalamazoo, Mich. Mine office: Encampment, Carbon Co., Wyo. Works a small force. Organized 1902, under laws of Wyoming, with capitalization $100,000, shares 10 cents par. H. E. Brown, president; E. S. Drury, vice-president and superintendent; W. C. Carson, treasurer. Lands, 10 unpatented claims, area 95 acres, in the Pearl district of Larimer Co., Colo., showing 2 fissure veins traceable 4,000′ and said to assay 2% to 50% copper, with traces of gold and silver. Ores are sulphide and oxide, carrying zinc, nickel and bismuth. Has 2 shallow shafts. Company contemplates beginning active development work in spring of 1903.

**KANSAS CITY COPPER MINING & SMELTING CO. COLORADO.**

Mine office: Oneco, Routt Co., Colorado. Oliver W. Kroll, superintendent. Has a copper ore body, opened by shaft and tunnels. Has steam and electric power; supposed to be installing a 40-ton smelter, but no returns secured.

**KANSAS CITY GOLD & COPPER MINING & MILLING CO. COLORADO.**

Incorporated August, 1902, to develop mines in Saguache Co., Colo. No returns secured.

**KANSAS CITY & SONORA MINING & MILLING CO. MEXICO.**

Office: 618 New York Life Bldg., Kansas City, Mo. Mexican office: Gabilan, Sonora, Mexico. Capitalization $1,000,000, shares $1 par. John H. Turner, president; A. O'Keefe, vice-president; Edgar Hubbard, secretary and treasurer; John W. Simpson, general manager. Lands, several old mines and adjoining claims, 38 miles from Hermosillo, Sonora. Several of the mines were worked a century or more ago for high-grade ores carrying copper, gold and silver. Employed about 35 men at last accounts. Company is composed of men of good standing, and financial affairs are in good condition.

**KAPUNDA COPPER MINE, LTD. AUSTRALIA.**

Offices: 8, Princes St., London, E. C., Eng. Mine office: Kapunda, South Australia. Sir E. J. Ackroyd, chairman; G. St. G. D. Massey, secretary. Registered Dec. 5, 1900, with capital, nominal, £120,000. The Kapunda mine is about 50 miles north of Adelaide and was opened in 1842. Has been worked by tributors since 1879, until recently. Has 4 veins; deepest shaft about 500′. Mine gives oxide and carbonate ores and some native copper. It is planned to sink deeper to secure sulphide ores.

**KARGALINSKI WORKS. RUSSIA.**

Address: care of E. O. Terner, Orenburg, Russia. Mine is in the government of Orenburg, and produced 18,849 poods of refined copper in 1899.

**KHAYYAM COPPER CO.**

Office: 150 Nassau St., New York, N. Y. No returns secured from the company, and no copper property discovered appertaining thereto.

**KILLINGDAL KOPBBERVAERK. NORWAY.**

Mines are northeast of Trondhjem, Norway. Operated by Bede Metal & Chemical Co., of Hebburn-on-Tyne, England. Produce cuprous iron pyrites, carrying about 2.5% copper, sold to burners in Norway and England. Production in 1900 was 17,700 tons ore. Annual copper production, 400 to 500 tons.

**KIMBALL CREEK MINING CO. WASHINGTON.**

Mine office: Berlin, King Co., Wash. W. H. Bruckart, superintendent. Ore body carrying gold, silver and copper is opened by tunnel; has water power; employs about 20 men.

**KING COPPER MINING CO., OF NEVADA. NEVADA.**

Eastern office; 431 Exchange Bldg., Boston, Mass. No returns secured.

**KING DEVELOPMENT CO. ARIZONA.**

Mine office: Jerome, Yavapai Co., Ariz. G. W. Hull, superintendent. Was developing the Jerome and "1888" claims, with small force, at last accounts.

**KING GOLD & COPPER MINING CO. WASHINGTON.**

Mine office: Davenport, Lincoln Co., Wash. Jas. B. Tuttle, manager. Ores carry gold and copper; mine opened by shaft and tunnel; has steam power; employs about 15 men.

**KING GOLD & COPPER MINING & MILLING CO. CALIFORNIA.**

Office: 921-185 Dearborn St., Chicago, Ills. Property, near Victor, San Bernardino Co., Cal. Company advertises to give an absolutely guaranteed investment, but writes under date Nov. 12, 1902, in response to request for information, that the property is not at present developed far enough to make much of a report on, and company preferred not to make any statement.

**KING MINING CO. WYOMING.**

Office: Fremont, Neb. Mine office: Riverside, Carbon Co., Wyo. T. Carroll, president and general manager; J. O. Bell, secretary; J. H. Knowles, treasurer.

**KINGMAN CLAIM. CALIFORNIA.**

Owned by Jas. McDonald, of Darwin, Inyo Co., Cal. Property near Darwin. Vein is a contact between limestone and granite, averaging about 3'; is opened by two short tunnels; ores are malachite, cuprite and calcopyrite, carrying a little gold and silver; property was developing at last accounts.

**KING SOLOMON MINE. BRITISH COLUMBIA.**

Located at Copper Camp, B. C. Produced 850 tons medium grade copper ore in 1901; stopped work in fall of 1901.

**KITANNING COPPER MINING CO. WASHINGTON.**

Office: 114 Cherry St., Seattle, Wash. Mine office: Index, Snohomish Co., Wash. W. C. Rutter, superintendent. A copper vein is being opened by tunnel, with 8 to 10 men.

**KITTICOOLA GOLD-COPPER MINE, LTD.** **AUSTRALIA.**

Address: care of T. S. Backhouse, Glenelg, South Australia. Has held property under lease from the Australian Mining Co., of London, since 1879. Is a small producer.

**KITTILSLAND KOBBERVAERK.** **NORWAY.**

Owned by N. Kior & Co., Christiania, Norway. Property thought to be idle; no returns secured.

**KJOLI GRUBE.** **NORWAY.**

At Reitan, Norway. Supposed to be owned by the Cape Copper Co. Mines were closed in 1901.

**KLEINKOGEL MINE.** **AUSTRIA.**

A very ancient mine in the Austrian Tyrol, said to be nearly exhausted, but still a small producer.

**KLONDIKE GROUP.** **UTAH.**

At Ibapah, Utah. Owned by C. M. Laird, et al. No returns secured.

**KNICKERBOCKER DEVELOPMENT CO.** **MONTANA.**

Mine office: Helena, Mont. Lands, 8 claims, just north of Helena, bought late in 1902 by this company.

**KNOCKMAHON MINES.** **IRELAND.**

Near Waterford, Ireland. Were producing nearly 1,000 tons yearly, circa 1840, but long idle. Averaged 10% copper, ores occurring in clay slates.

**KOMAKI MINE.** **JAPAN.**

Located in the provinces of Ugo and Rikuchu, Japan. A very old mine, giving considerable gold as a by-product. Annual production, according to latest returns secured, averages about 1,000,000 pounds.

**KOOTENAI COPPER-GOLD MINING CO.**

Office: 15 Exchange pl., Jersey City, N. J. Incorporated November, 1902, under New Jersey laws, with capitalization $500,000, by Horace B. Gould, John R. Turner and Louis B. Dailey. No returns secured.

**KOOTENAI COPPER MINING & SMELTING CO.** **IDAHO.**

Supposed to have property in the neighborhood of Port Hill, Idaho. No returns secured.

**KOSK CREEK GROUP.** **CALIFORNIA.**

Near Olena, Shasta Co., Cal. Bonded to W. G. Scott, et al, of San Francisco. Native copper is found in nodules and thin sheets in the joints of the upper portion of a 200′ strata of dark basaltic rock. Sulphide ores occur at greater depth.

**KREMLIN MINING CO.** **UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. D. M. Houston, superintendent. Ore carries copper and gold; has steam power, and employs a small force.

**KUPFERPLATTE MINE.** **AUSTRIA.**

Mine office: Kitzbuehel, Tyrol, Austria. Horizontal beds of chalcopyrite with quartz gangue occur in slates of Silurian age. This mine is one of the principal copper producers of the Austro-Hungarian Empire.

**KURTZ-CHATTERTON COPPER MINING CO. WYOMING.**

Office: 310 Fisher Bldg., Chicago, Ills. Mine office: Encampment, Carbon Co., Wyo. Capitalization $1,000,000, shares $1 par. L. D. Godshall, superintendent. Lands, 100 acres, developed by 1,700′ tunnel, which cuts 7 veins of low-grade copper ore, the widest 17′, giving average assays of 5% copper, with traces of gold. Was sinking a 1,000′ shaft to prove the property at depth, at last accounts. Has a 100-ton concentrator. This is one of the best developed and most promising of the Wyoming copper properties.

**KUSAKURA MINES. JAPAN.**

See Furukawa Copper Company.

**KVANANGENS KOBBERGRUBER. NORWAY.**

Owned by Consul Nils Persson, Helsingborg, Sweden. Mine office: Kaafjord, Finmarken, Norway. Otto Witt, general manager; P. W. George, mining engineer; Peter Iversen, mining captain. Lands, 50 patented claims, area 300 acres, showing about 20 fissure veins of sulphide ore, in pyrite, these having an average width of 3′ and length of 1,000′. Will continue development work during 1903.

**LACLEDE CONSOLIDATED GOLD & COPPER MINING CO. OREGON.**

Mine office: North Powder, Union Co., Ore. J. H. Downs, superintendent. Is developing gold-copper ores by tunnel.

**LA FLORIDA MINING, MILLING & DEVELOPING CO. MEXICO.**

Mine office: supposed to be at Moctezuma, Arispe district, Sonora, Mex. A. S. Barker, secretary and treasurer. Company advertised stock for sale at $5 per share, but letter mailed to company's address at Naco, Ariz., returned unopened with notation that the president is dead.

**LA LAPILLA MINE. SPAIN.**

Mine office: Alosno, Huelva, Spain. Wm. Guthrie Bowie, manager. Property adjoins the Tharsis and consists of a group of government concessions. Has an extensive plant. Ore ranges from 2.5% to 8% copper and 47% to 50% sulphur. Ore body, lenticular and very wide; mine was formerly operated by pillar-and-stall, leaving large quantities of ore in the floors and pillars. Has about 1,200,000 tons of ore available, and much more if worked open-cast. Output lessened because of poor ventilation. Property shows enormous quantities of scoria, left by the Romans.

**LA SAL COPPER MINING CO. COLORADO.**

Office and mine: Cashin, Montrose Co., Colo. Employs 60 men. Organized 1899, under laws of Colorado, with capitalization $100,000, shares $100 par. Has paid dividends of $24,000. L. G. M. Gates, president and treasurer; S. S. Sherman, vice-president; Jas. N. McBride, secretary and general manager. Lands, 10 claims, 7 patented, area 150 acres. Vein has average width of 5′, assaying 8% copper, with good gold and silver values. Has 1 shaft and 3 tunnels, with 5,000′ of underground openings. Ore blocked out for stoping, 27,000 tons. Water and steam power. Has a small but complete smelter at the mine, and ships product as matte carrying 49% copper and 1,200 oz. silver per ton. Also has a leaching plant. Estimated copper production for 1903 is 3,000,000 lbs.

**LABOR COOPERATIVE GOLD, SILVER & COPPER MINING CO.** **BRITISH COLUMBIA.**

Office: Oconto, Wis., Chicago, Ills., Detroit, Mich., or elsewhere. Registered Canadian office: Revelstoke, B. C. Mine office: Golden, B. C. Organized under British Columbia laws, with capitalization $150,000, shares 10 cents par. Philip Chesley, president; C. Peterson, vice-president; Rev. C. E. Nylin, secretary and treasurer.

Concern was promoted early in 1902, and one of the company's circulars, offering stock, is a remarkable production, filled with scriptural quotations and breathing from every line a philanthropic desire to aid the poor working people. Company's affairs have been managed with great laxity and many misrepresentations have been made. The secretary-treasurer is, or was, a preacher, of the Baptist denomination, and apparently has "baptised" this company by injecting the enterprise full of water. Company owns a store and newspaper at Golden. Is also said to have a smelter, but apparently has no mine to feed it.

Mining is a business enterprise, when honestly conducted, and neither a prayer-meeting nor an elemosynary institution. Any mining company that issues prospectuses filled with quotations from the bible, or circulars glowing with a desire to enrich the poor, down-trodden workingman, may be set down, once and for all, as a concern with a management that is either dishonest or incompetent, or both.

**LADY CHELAN COPPER CO.** **WASHINGTON.**

Office: 234 Hyde Blk., Spokane, Wash. Property presumably near Lake Chelan. No returns secured.

**LADY HELEN COPPER MINING CO.** **ARIZONA.**

Mine office: Pima, Graham Co., Ariz. Organized under New Jersey laws, with capitalization $1,000,000, shares $1 par. A. J. Halter, president. Lands, 100 acres in the Clark district, Graham Co., Arizona. No returns secured; former secretary writes that he knows nothing about the company.

**LADY POND MINE.** **NEWFOUNDLAND.**

At Lady Pond, Newfoundland. Property was taken up and reopened by the Newfoundland Copper Co., circa 1900, but work has been discontinued.

**LAKE GEORGE MINES, LTD.** **AUSTRALIA.**

Offices: 10, Walbrook, London, E. C., Eng. Mine office: Bungendore, Captain's Flat, N. S. W. A. J. Marks, chairman; H. R. Westall, secretary. Capital, nominal, £180,000. Property, 615 acres, of which 172 acres are freehold, at Captain's Flat, Lake George, 25 miles from the Cooma railroad and about 175 miles south of Sydney. Mine opened 1882, and is about 600′ deep; made 496 tons refined copper in 1899, from ores averaging 1.5% copper and carrying small gold and silver values. Vein is 22′ to 30′ wide and very persistent, having a meridional strike and vertical dip, in a country rock of Silurian slates. Ore occurs as replacements along fault lines, rather than in veins, and walls are very imperfectly defined. Was operated originally as a gold mine and the gossan outcrop is cyanided for gold values. Ore is a compact, fine-grained mixture of iron pyrites, galena, zinc blende and chalcopyrite, with an aluminous quartzose gangue, and is very refractory. Has four 60-ton water-jacket blast furnaces, using 50% flux and 50% fuel charges. Also employs pyritic smelting. Present production is about 900 tons of fine copper yearly, product being sold as matte of 30% to 35% tenor, carrying about 5 oz. gold and 200 oz. silver per ton of blister copper.

**LAKESIDE GOLD-COPPER MINING CO. WASHINGTON.**

Office: Spokane, Wash. Capitalization $1,000,000, shares $1 par. Geo. W. Weatherbee, president; Frank Kimball, vice-president; L. A. Sweetser, secretary and treasurer; E. W. Berry, general manager; directors are preceding officers, E. S. Morse, Jas. A. Ewing and J. W. Douglas. Property, 7 claims in the Index district of Washington.

**LAKE SUPERIOR MINE. MICHIGAN.**

Consists of 640 acres in Sections 13 and 14, Town 50 North, Range 39 West, Ontonagon Co., Mich. Carries the northeasterly continuations of the Evergreen and other lodes found on the Mass and Adventure lands. Property long idle.

**LAKE SUPERIOR CONCENTRATING CO. MICHIGAN.**

Office: Houghton, Mich. Has a 250-ton sludge plant on the old Franklin sands, at Hancock, Mich. T. G. Mays, superintendent.

**LAKE SUPERIOR COPPER & ZINC CO. ONTARIO.**

Office: 20 Broad St., New York. Capitalization $1,000,000, shares $5 par. C. L. Blakeley, president; Ira Mowry, secretary. Has mineral land in Algoma, Ont., near the northern shore of Lake Superior.

**LAKE SUPERIOR POWER CO. ONTARIO.**

Office: Sault Ste Marie, Ont. Mine office: Gertrude Mine, via Sudbury, Algoma, Ont. Employs 150 men. F. H. Clergue, general manager; Thos. Travers, superintendent; Ernst A. Sjöstedt. mining engineer; Thos. Williams, mining captain. Lands, 7 claims, area about 2,000 acres, including the Gertrude and Elsie nickel-copper mines, in Creighton Twp., Algoma, Ontario, showing 4 ore bodies carrying cupriferous and nickeliferous pyrrhotite, in contact veins. Has shafts of 50′, 60′, 80′ and 100′, with about 1,000′ of underground openings. Estimated ore in sight, 500,000 tons; blocked out for stoping, 50,000 tons. Has steam plant with 7 tubular boilers and 4 hoists. Has a smelter, receiving ore by rail from the Gertrude and Elsie mines. Smelter has a Herreshoff water-jacket furnace, with daily capacity of 150 tons. Product is turned out as matte averaging 10% copper and 20% nickel. Mine and smelter are served by the Manitoulin & North Shore Ry. Company contemplates adding two 150-ton furnaces in 1903, and will continue extensive development work.

**LAKE SUPERIOR & BISBEE DEVELOPMENT CO. ARIZONA.**

Office: Calumet, Mich. Mine office: Bisbee, Cochise Co., Ariz. No returns secured.

**LAKE SUPERIOR & PITTSBURG DEVELOPMENT CO. ARIZONA.**

Office: Calumet, Mich. Capitalization $400,000, shares $10 par. Chas. Briggs, president; John S. Dymock, vice-president; Peter Ruppe, treasurer; Gordon R. Campbell, secretary. Property, near Bisbee, Cochise Co., Ariz.,

was formerly owned by the South Bisbee Townsite & Improvement Co. Lands, 44 patented and 2 unpatented claims. Has 2 shafts, of 650′ and 1,030′, with about 2,000′ of drifting. Company is doing extensive development work, with ample capital and good management, and results secured are quite promising.

**SUCESION C. J. LAMBERT. CHILE.**

This company, founded by the pioneer copper smelter of Chile, operates La Compania mine, opened 1850, at Brillador, Serena, Chile, making therefrom 500 to 700 tons of bars yearly. Also owns the Bronces mine, 550′ deep, opened 1840, which was idle at last accounts.

**LAS ADARGAS MINING CO. MEXICO.**

Office: 15 John St., New York. Mine office: Jiminez, Chihuahua, Mexico. Claims to be organized under laws of New York, with capitalization $1,000,000, shares $10 par. E. G. Sieler, president; Jos. Kessler, vice-president; Geo. E. Crawford, secretary; Edw. Emrick, treasurer; W. A. Seamon, general manager, El Paso, Texas. A dividend of 25 cents per share was declared in April 1902. Property is said to be held under a bond of $300,000, of which $15,000 has been paid. Has 300′ shaft. No returns secured.

**LAS ANIMAS GOLD-COPPER MINING CO. NEW MEXICO.**

Office: 50 State St., Boston, Mass. Mine office: Hillsboro, Sierra Co., N. M. Employs 15 men. Organized 1900, under laws of West Virginia, with capitalization $1,000,000, shares $1 par. Annual meeting in January. Jas. P. Mallette, president and general manager; Michael F. Burke, vice-president; Wm. D. T. Treefry, secretary and treasurer. Directors are preceding officers, Chas. B. Eggleston and Hamilton Merritt. W. W. Williams, superintendent; L. W. Getchell, consulting engineer. Lands, 4 claims, 3 patented, in the Hillsboro district of Sierra Co., showing a fissure vein averaging 8′ wide with length of 3,500′, and giving assay returns of about 10% copper, 2 oz. gold and 15 oz. silver per ton, from oxide and sulphide ores. Shafts, 150′ to 400′ in depth, also 3 tunnels. Has 4,000′ of underground openings. Estimated ore in sight, 100,000 tons; blocked out for stoping, 60,000 tons. Steam and gasoline power. Has hoist good for depth of 1,000′. Nearest railroad, 22 miles. Company contemplates building a 50-ton concentrator, sinking the main shaft and opening additional levels during 1903.

**LAS TUSAS MINING & MILLING CO. NEW MEXICO.**

At Tres Piedras, Rio Arriba Co., N. M. Lon L. Trout, general manager. Is developing gold and copper ore body; has electric power. Said to be contemplating erection of stamp mill and smelter.

**LAS VEGAS COPPER CO. NEW MEXICO.**

Office: East Las Vegas, N. M. Said to have 5,000,000 tons of 4% carbonate ore. Is building a mill and electric plant. F. A. Manzanares, president; W. H. Smith, vice-president; J. M. Thompson, secretary; J. M. Allen, treasurer and general manager; F. J. Buck, consulting mining engineer. Capitalization $100,000, shares $1 par.

**LAST CHANCE MINE. UTAH.**

See New England-Utah Mining Co.

**LIBERTY MINING & SMELTING CO.** **ARIZONA.**

Mine office: Tucson, Pima Co., Ariz. Wm. R. Wemple, manager. Mine shows silver, lead and copper ores; opened by shafts; gasoline power; employs about 20 men.

**LIBIOLA COPPER MINING CO., LTD.** **ITALY.**

Offices: 16 Leadenhall St., London, E. C., Eng. Mine office: Sestri Levante, Genoa, Italy. K. H. James, chairman; W. S. Bartlett, secretary. Reorganized May 8, 1888, with capital of £252,000, in 50,400 shares of £5. Paid annual dividends 1888 to 1901. Property, copper mines near Sestri Levante, Liguria, Italy and a half interest in the Cruccuen silver-lead mine, in Sardinia, latter now idle. The copper mines are very ancient, and are held through an Italian company, capital stock of which is owned by the parent corporation. Ore reserves of the Sestri Levante mines are estimated as equal to 3 years production. Ore is mainly low grade chalcopyrite, in veins occurring in serpentine and diabase.

**SOCIETA ANONIMA PER L'ESERCIZIO DELLA MINIERA DE LIBIOLA.** **ITALY.**

See Libiola Copper Mining Co., Ltd.

**SOCIETE DES MINES DE LA LIENNE.** **ITALY.**

Office: probably Paris. Mines, at Alagna and Riva, Circondario di Varallo, Novarra, Italy. Was working a medium-grade chalcopyrite ore at last accounts. No returns secured.

**SOCIETA LIGURE RAMIFERA.** **ITALY.**

Mine office: Casarza, Genoa, Italy. Mines include the Fontanelle, Rio Albareta, Rio Monticelli and Rio dei Fichi. The ore occurs as chalcopyrite in a quartzose gangue. Mines are producing on a limited scale. No returns secured.

**LILYAMA MINE.** **CALIFORNIA.**

Owned by Robert Crocker & Co., Placerville, Cal. Property consists of 240 acres of patented lands in El Dorado Co., 11 miles from Auburn, Placer Co., Cal. Ores, principally sulphides, occur as lenses in limestone lying between granite and quartz porphyry. Property opened by four tunnels and a prospecting shaft.

**LIMA COPPER MINING SYNDICATE, LTD.** **PERU.**

Offices: 8, Union Court, Old Broad St., London, E. C., Eng. Col. J. Harris, chairman. It cannot be learned that this company owns any mining property.

**LIME CREEK COPPER CO.** **ARIZONA.**

Office: Creighton Bldg., Phoenix, Ariz. Mine office: Lime Creek, Yavapai Co., Ariz. Capitalization, $500,000. A. J. Edwards, president; J. D. Marlar, secretary; S. S. Green, treasurer; J. W. Monday, superintendent. Lands, 480 acres lying 60 miles northeast of Phoenix, some distance from a railroad. Was working 30 men at last accounts, and has several shafts and tunnels. Ore assays 5% to 40% copper and $8 to $10 gold per ton; ore body has extreme width of 65'. Has a 10-ton smelter at the mine, and has been using a 30-ton smelter at Alhambra. Showing at the mine is said to be good, and company is well spoken of locally.

**COMPANIA LIMITADA. CHILE.**

Operates the Fundicion Templeman mine, opened 1897, in the department of Antofagasta, Chile, producing therefrom about 1,500 tons of copper yearly.

**LINCOLN MINE. UTAH.**

At Minersville, Beaver Co., Utah. Gus Stoney, superintendent. Is said to have steam power and silver, lead and copper ores, opened by shaft.

**LINCOLN COPPER DEVELOPMENT CO.**

Office: 326 Post St., San Francisco, Cal. Lands, presumably in California, but no returns secured.

**LINCOLN COPPER MINING CO. ARIZONA.**

Office: 321 Spruce St., Aurora, Ills. Capitalization $3,000,000, shares $1 par. Names of officers unobtainable, despite repeated attempts. Lands, 42 claims, area about 850 acres, in the Sierrita Mountains, near Tucson, Pima county, Arizona. Property said by newspaper dispatches in summer of 1902 to have been sold for $6,000,000 cash to John D. Rockefeller, but rumor probably not true, as Mr. Rockefeller has since been able to make his usual Christmas gift to the University of Chicago. Property said to have a 100-ton smelter, and is probably under lease to E. W. Brinker, 614 Adams Express Bldg., Chicago, Ills., but no returns secured from him, the company, nor any other interested party.

**LINEDALE WEST CHILLAGOE, LTD. AUSTRALIA.**

Offices: Melbourne, Australia. Thos. Rollason, secretary. Said to have a 7′ vein with 3′ pay streak carrying 20% copper, 2 dwts. gold and 10 oz. silver per ton. Property needed pumps and company needed money, at last accounts from Australia.

**LITTLE BAY MINE. NEWFOUNDLAND.**

Opened 1878 and closed 1892. Was under option to the Newfoundland Copper Co., circa 1900, but was not taken. Was a considerable producer at one time, having a 1,350′ shaft and a smelter.

**LITTLE GIANT MINING CO. WASHINGTON.**

Mine office: Marcus, Stevens Co., Wash. J. B. Reynolds, superintendent. Is supposed to be developing a copper vein by shafts; no returns secured.

**LIVE OAK COPPER MINING & SMELTING CO. ARIZONA.**

Office: 438 Broome St., New York. Mine office: Globe, Gila Co., Ariz. Organized under laws of Arizona, with capitalization $1,200,000, shares $1 par. F. J. Kaldenberg, president; Forest J. Kaldenberg, vice-president and secretary; W. G. Augustin, treasurer. Lands, in the Globe district of Gila Co. No returns secured.

**LIVERMORE GOLD & COPPER MINING CO. WYOMING.**

Organized May, 1902, with capitalization $1,000,000, to take over the Cumberland, Empire, Flying Duchman, Eureka and Everett mining claims, in the vicinity of Laramie, Wyo. No returns secured.

**LLANOS BLANCOS & LOS PATOS MINES. CHILE.**

At Tamaya, Tongoya, Ovalle, Chile. Opened 1893 and 250′ deep. Supposed to be idle. No returns secured.

**"LLOYD" COPPER CO., LTD. AUSTRALIA.**

Offices: 195A, Winchester House, London, E. C., Eng. Mine office: Burraga, Bathurst, New South Wales. A. C. Arthur, chairman; L. Malleson, secretary. Capital, nominal, £250,000; debentures, £15,000 authorized. Property, 318 acres freehold and 375 acres leasehold, in Bathurst district, N. S. W. Mine was opened 1877. Employs about 500 men. Production in 1901 was 1,059 tons copper, from 21,508 tons of ore. Ore is slightly argentiferous chalcopyrite with quartzite gangue, occurring in acid diorite. Mine is about 800′ deep. District is arid. Mine has a dam with storage capacity of 85,000,000 gallons, sufficient for 9 months supply, which is not always adequate. A new plant, costing £32,000, was built in 1901. This has a concentrator, also smelter with modern reverberatory furnaces. Has an electric plant and consumes 60,000 cords of wood yearly for fuel.

**LOG CABIN GOLD & COPPER CO., LTD. ONTARIO.**

Office: 1103 D. S. Morgan Bldg., Buffalo, N. Y. Has gold claims near Mine Centre, Rainy River district, Ontario, also sundry copper claims. No returns secured.

**LOMAGUNDA DEVELOPMENT CO. RHODESIA.**

Offices: probably London. Has found copper on the Alaska and Hard Times claims, in the Lomagunda mining district of Rhodesia.

**LOMA VERDE COPPER CO. ARIZONA.**

Office: 316 Bradbury Bldg., Los Angeles, Cal. Mine office: Tucson, Pima Co., Ariz. Employs 8 to 10 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par. T. C. Paxton, president and general manager; C. M. Wood, vice-president; E. Frank Campbell, secretary; H. T. Coffin, treasurer; L. B. Lewis, superintendent; N. E. Isbell, mining engineer. Lands, 16 claims, area 320 acres, showing fissure veins carrying ore assaying 23% copper and $5 gold per ton. Has 3 shafts, aggregate depth 550′, also 3 tunnels, aggregate length 475′. Will continue development work in 1903.

**LOMBARD COPPER CO.**

Organized at Baker City, Ore., July 19, 1902, by F. L. Evans, H. C. Pearson and W. G. Main, with capitalization $2,000,000. No returns secured.

**LONE PINE MINING CO.**

An offspring of the Arizona, Eastern & Montana Co. Had offices at 20 Broad St., New York. Apparently has defective title and is a very dubious proposition.

**LONE STAR MINE. ARIZONA.**

At Williams, Coconino Co., Arizona. Rounseville & Hardesty, owners. Is developing copper claims by an open cut, with small force.

**LONE STAR COPPER CO. TEXAS.**

Company by this name, capitalized at $375,000, with W. A. Dennis, president; John McNeish, secretary and Henry J. Brennon, manager, was developing carbonate and oxide ores, by tunnel and shaft, at Henrietta, Clay Co., Texas, in 1899. No returns secured and company probably out of business.

**LOOKOUT GROUP.** **ALASKA.**

At Niblack Anchorage, Prince of Wales Island, Alaska. In charge of H. H. Wakefield and Edward Fink, of Ketchikan, Alaska. Claims are 6 in number and properties are said to have a large body of medium-grade ore.

**COMPANIA MINERA LORETO Y PROVIDENCIA.** **MEXICO.**

Mine office: Candamena, Chihuahua, Mexico. Owned by Jesus Poyval, Rascon Bros. and F. R. Bones. Property carries silver, copper and lead. Opened by 500′ shaft and 900′ tunnel. Water power is used; mine has 3-stamp mill and smelter; employs about 100 men.

**LORRAINE COPPER MINING CO.** **WASHINGTON.**

Office: Hoquiam, Wash. Mine office: Keller, Ferry Co., Wash. Owen Jones, president; J. W. Hull, vice-president; L. H. Chambers, secretary; Jos. Stearns, treasurer. Lands, 6 claims, in the Carbon River district of Pierce Co., and 10 claims in the Keller district, Southern Colville Reserve, Ferry Co., Wash. Has about 2,000′ of development work, and assays have shown large values in gold, copper and silver.

**LOS OSOS MINE.** **CALIFORNIA.**

At San Luis Obispo, San Luis Obispo Co., Cal. Owned by J. M. Cleaves Estate, San Francisco, Cal. Was worked, circa 1865, by shafts and tunnel, ore occurring in a porphyritic vein in sandstone and shales. Property idle at last accounts.

**LOST GULCH COPPER CO.**

Office: 218 So. Broadway, Los Angeles, Cal. No returns secured and location of property unknown.

**COMPANIA ESPLOTADORA DE LOTA Y CORONEL.** **CHILE.**

Owns and operates mines in different parts of Chile. Principal property is the Lota mine, in the department of Lautaro, opened in 1856 and making about 15,000,000 pounds of copper annually, shipped to Europe as bars and ingots. Also operates the Maitenes mine, in the department of Santiago, opened 1884, which makes about 1,000,000 pounds of refined copper annually. Company also owns the Descubridora mine, at Carrizalillo, Chañaral, Chile, opened 1850, and about 650′ deep.

**MINA DO LOUZAL.** **PORTUGAL.**

Office: 4, Praca dos Romulares, Lisbon, Portugal. Mine office: Louzal, Grandola, Portugal. Employs 60 men in development work and is owned by a syndicate, with Senhor Dom W. d'Orey as general manager and Joaquin Chaves as mining captain. Lands include two claims, area about 1 square kilometer, in the Grandola district, having two lenses of ore with an average width of 60′, other dimensions unknown, carrying principally chalcopyrite, with some oxides and a little native copper, giving returns of 0.5% to 12% copper, and considerable values in silver. Has 7 shafts, 20 to 30 metres deep, with about 400 metres of tunnels. Estimated amount of ore in sight, 3,000,000 tons. Animal power used. Nearest railway, about 25 miles. Owners will continue development work in 1903.

**LOW DIVIDE COPPER MINING CO.** **CALIFORNIA.**

John Murray, president, Crescent City, Cal. Company owns the Alta, Occidental and Copper Hill groups, in Del Norte Co., Cal. Several different veins have been opened to some extent, these showing oxide, carbonate and high-grade sulphide ores.

**LOWER MAMMOTH MINING CO.** **UTAH.**

Office: Salt Lake City, Utah. Mine office: Mammoth, Juab Co., Utah. Simon Bamberger, general manager. Has steam and electric power. Employs upwards of 100 men. For 1902 company's receipts were $83,280, against expenses of $76,698, latter including payment of a $15,278 overdraft, showing an actual profit of $21,800 on the year's operations. Ores treated during 1902 averaged 3% copper, 52 oz. silver and 85 cents gold per ton.

**LUCKY VERDE COPPER CO.** **ARIZONA.**

Office: 523 Douglas Blk., Los Angeles, Cal. Mine office: Jerome, Yavapai Co., Ariz. Employs 4 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par. Milo Baker, president; A. J. Gastren, vice-president; W. T. Somes, secretary and treasurer. Lands, 15 unpatented claims, area about 300 acres, showing several fissure veins giving good assay values in copper, gold and silver, from oxidized ores near surface and sulphide ores at slight depth. Has several shallow shafts. Company contemplates deepening shaft and installing hoists in 1903.

**LUDWIG COPPER MINING CO.** **NEVADA.**

Mine office: Yerington, Lyon Co., Nev. A. Pugh, manager. Is opening a copper ore body by shafts; steam power; 30-ton smelter; employs about 25 men.

**LUKE CREEK GOLD-COPPER MINING CO.** **BRITISH COLUMBIA.**

Office: 435 Temple Court, Minneapolis, Minn. Mine office; Marysville, Fort Steele division, East Kootenai, B. C. Capitalization, $1,000,000, shares $1 par. S. D. Pompelly, president and general manager; Dr. W. H. Fisher, vice-president; E. D. Barcalow, secretary; N. J. Mortensen, treasurer. Lands, 2 claims, area 110 acres. Was doing development work at last accounts.

**LYELL COMSTOCK MINE.** **TASMANIA.**

At last accounts company was prospecting with 25 men, and branch railroad line was being built from mine to Linda, by means of which ore will be conveyed to the North Lyell smelting plant at Crotty, Tasmania.

**LYELL PEAKS MINE.** **TASMANIA.**

In the Mt. Lyell district of Montague Co., Tasmania. A prospect only.

**LYELL PIONEER CONSOLIDATED.** **TASMANIA.**

In the Mt. Lyell district of Montague Co., Tasmania. Work was suspended June 11, 1902.

**LYELL THARSIS MINING CO.** **TASMANIA.**

Offices: Finsbury House, London, E. C., Eng. P. W. Orr, chairman; E. Habben, secretary; J. Potts, 31, Queen St., Melbourne, Australia, assistant secretary; W. H. Vale, mine manager; Hon. N. J. Brown, agent, Hobart, Tasmania. Capital, nominal, £150,000. Small dividends were paid 1899 to 1901. Property opened 1897; largest annual production, about 1,000 tons of copper. Ore averaged 3.5% to 5% returns in smelter. Original deposit is apparently exhausted; company is conducting diamond drill explorations only, with 10 to 15 men.

**LYMNI COPPER MINING SYNDICATE, LTD. CYPRUS.**

Offices: 32, Victoria St., London, S. W., Eng. Mine office: Limassol, Cyprus. Employs 80 men. Organized 1897, with capitalization £20,000, shares £1 par, with 15,000 shares issued, of which 12,264 are fully paid, 736 paid 15 shillings and 2,000 paid 5 shillings. L. P. Ford, chairman; Thos. Cresswell, F. I. S., secretary; directors are preceding officers, Sir Henry J. Bimbury, Bart., L. P. Ford, A. H. D. Cochrane and H. C. Lea. Chas. Christian, general manager at mines. Mineral lands, 30 square miles, in the Bellathousa district of Colis, Chrysokhow, Cyprus. Ore occurs as lenses only, one having a width of 400′ and length of 1,400′. Estimated average ore values, 9% to 10% copper and 3 dwts. silver per ton. Ores are bornite and chalcopyrite. Mine is developed by 7 shafts, 150′ to 300′ deep, and one tunnel of 2,100′. Ore formation apparently continuous for three miles. Company will continue development work in 1903. Mine has no permanent equipment as yet, and no production was secured in 1902.

**LYNGENFJORD KOBBERVAERK. NORWAY.**

A small property having an aerial tram to Kaafjord, Finmarken, Norway. No returns secured.

**LYNN CREEK COPPER-GOLD CO., LTD. BRITISH COLUMBIA.**

Office: Flack Bldg., Vancouver, B. C. Mine office: Lynn Creek, Vancouver, B. C. Company intends employing 30 men during 1903. Organized 1901, under laws of British Columbia, with capitalization $300,000, shares $5 par. G. L. Allan, president and treasurer; Jas. R. Webster, vice-president; W. H. Pegram, secretary; W. Thos. Newman, general manager; G. Richardson, superintendent. Lands, 6 claims, area 200 acres, in New Westminister district of British Columbia, 8 miles from Vancouver, showing 6 veins, of which 3 run 5′ to 40′ in width, with estimated average length of 1,000′, and known depth of 800′, assaying 8.9% copper, $1 gold and 3 oz. silver per ton. Also has a 4′ to 6′ vein of zinc ore, opened by 2 tunnels which will give a back of 800′ to 1,000′. Property is said to have a large amount of ore in sight. Can ship ore by boat to smelters at Crofton, Ladysmith and Van Anda. Company will install a direct-coupled Pelton water wheel and electric generator to operate a lighting plant and electric drills, and contemplates very extensive underground development, during 1903. Will not ship until reserves blocked out warrant extensive contracts. Will probably begin production in 1904.

**MAADEN-KENI MINES. TURKEY.**

At Baibourt, near Trebizond, Asia Minor. Was being worked, in a very small way, by a Greek syndicate, at last accounts.

**McCABE EXTENSION MINING & MILLING CO.** **ARIZONA.**

Office: Prescott, Ariz. Mine office: McCabe, Yavapai Co., Ariz. Reese M. Ling, president; E. R. McDowell, secretary; J. H. Farrell, superintendent. Has several claims adjoining the McCabe mine. Main shaft 300′ deep. Property well spoken of and the directors are men of good standing. Rumored late in 1902 that company would be reorganized.

**McCOY GROUP.** **ARIZONA.**

Near Globe, Gila Co., Arizona. C. E. Taylor, owner. Has a copper ore body, opened to a limited extent by shafts and tunnels.

**McKINLEY MINING & SMELTING CO.** **NEVADA.**

Mine office: Ely, White Pine Co., Nev. Capitalization, $1,000,000. M. C. Barber, president; F. E. Fitch, vice-president; Dix W. Smith, secretary; A. J. Hazeltine, treasurer; W. N. McGill, superintendent. Property was worked as a gold mine some years ago and is said to have a shaft of 300′ depth, and about 1,000′ of drifts. Property carries gold above with copper ores in lower workings.

**McQUEEN MINE.** **MONTANA.**

Eight claims lying a short distance east of the developed copper zone of Butte, Silver Bow Co., Mont. Was under bond and lease to Franklin Farrell, at last accounts.

**MAGENTA GOLD MINING CO.** **COLORADO.**

Mine office: Granite, Chaffee Co., Colo. C. E. Barrie, superintendent. Has gold, silver and copper ores, opened by shaft. Has steam power and employs about 25 men.

**MAGISTRAL COPPER MINES.** **MEXICO.**

Office and mines: Magistral, Chihuahua, Mex. Enrique C. Creel, secretary; John Weir, manager. Lands, 35 pertenencias, area about 85 acres. Has 300′ shaft. Has steam and gasoline power and a 150-ton smelter. Employ about 200 men.

**MAGNETAWAN MINING CO.** **ONTARIO.**

Office: Connellsville, Pa. R. S. Hews, secretary. Mining property is at Burks Falls, Parry Sound district, Ontario. No returns secured.

**MAGPIE GOLD & COPPER MINING CO.** **WYOMING.**

Is developing claims on the south fork of the Encampment river, near Riverside, Carbon Co., Wyoming.

**MAINE & MONTANA COPPER CO.** **MONTANA.**

Office: probably Fort Fairfield, Me. Mine office: Basin, Jefferson Co., Mont. No returns secured.

**COMPANIA MINERA DE MAIPU.** **CHILE.**

Operates El Volcan mine, opened 1884, in the department of Victoria, Chile. Annual production is equivalent to about 1,000,000 pounds of refined copper.

**JOAQUIN MAIZ & CO.** **MEXICO.**

Office and mines: Villa Aldama, Nueva Leon, Mexico. C. Robles, manager. Employ about 200 men. Mines opened by tunnels. No returns secured.

**MAJDANPEC MINES.** **SERVIA.**

At Majdanpec, Servia. Cement copper is produced on a limited scale by lixiviation.

**MAJESTIC COPPER MINING & SMELTING CO.** **UTAH.**

Office: 612 Dooly Blk., Salt Lake City, Utah. Mine office: Milford, Beaver Co., Utah. Employs 150 men. Organized 1900, under laws of Colorado, with capitalization $6,000,000, shares $10 par, non-assessable. A. B. Lewis, president; W. H. Alexander, vice-president; C. J. Caughey, secretary; W. B. Mucklow, treasurer. Directors are preceding officers and Gus H. Rinley. W. A. Farish, general manager; Josiah Osborne, superintendent; Wm. Cachmann, smelter superintendent.

Lands, 120 claims, 21 patented, 99 unpatented, area 2,450 acres, also 80-acre smelter site and 1,100 acres miscellaneous lands, located in 5 districts of Beaver Co., Utah, and showing about 100 copper ore bodies in 20 or more different groups of mines and prospects. In addition to copper the ores carry gold, silver, platinum, lead, cobalt, bismuth, vanadium, uranium, etc. Ores include all of the principal oxides, carbonates and sulphides, also native copper and many of the rarer copper minerals, ranging in tenor from 2% to 85% copper. Average value of ore is estimated by company at 12% copper, $3 gold and 12 oz. silver per ton, with large percentages of lead. There are 18 shafts of 100′ to 400′ in depth, also many tunnels and innumerable test-pits. Underground development, about 30,000′; ore in sight, estimated at 1,000,000 tons, with about 500,000 tons blocked out for stoping. Final payments on lands were made October 1902, giving the company absolute title. The lands include 8 separate groups of mines, some of which were formerly worked for silver, but the silver-copper ores at and near surface gave way to copper-silver ores at depth, all of the ores being more or less auriferous. In addition to the high-grade ore bodies, there are what the company calls low-grade ores, estimated by President Lewis to average about 8% in copper.

The O. K. is the principal mine of the company, and probably has produced more extremely high-grade ore than any other copper mine in the world has ever secured from similar development. Shipments of 258 tons in 1901 gave smelter returns of 40% copper, $3.80 gold and 7.5 oz. silver per ton, and the mine has shipped about 1,400 tons, all told, which ore has averaged 40% copper and $5 to $10 per ton in gold and silver values. Total shipments of 1,145 tons to Jan. 1, 1902, gave net returns of $95,000. The O. K. group consists of 7 claims, and has what is apparently one of the largest bodies of phenomenally high-grade copper ore ever opened, this vein being as wide as 28′ and carrying 30% to 60% copper. The 3-compartment main shaft is 400′ deep and is in ore from grass-roots. The main development is on the 300′ and 400′ levels, where the vein has reached an extreme width of 50′. The 300′ level shows a great deal of cuprite, and there is much native copper on the 400′, or bottom, level. This mine has on the dumps about 20,000 tons of "low-grade" ore, giving an average assay of 6.6% copper, $1.60 gold and 4 oz. silver per ton. The claims also carry an undeveloped ore body, traced approximately 300′, with a width of about 250′ showing a network of veins and stringers carrying high-grade ores. The O. K. has caves, containing curious stalactitic formations.

The Old Hickory group has 9 claims, showing an outcrop of iron ore 250′ wide, below which it is thought that copper will be found. Developments include about 50 pits and shafts, of 10′ to 80′ in depth, all of which are bottomed in ore averaging 4% to 5% copper, with gold and silver values of $2 to $4 per ton. The vein is 250′ wide in places, and will average probably 125′ to 150′. Three shafts, opened in a distance of about 450′ along the strike, show a vein 40′ to 200′ wide, carrying 5% to 50% copper ore. The 2-compartment main shaft is now sinking and a tunnel is being pushed to intersect the shaft. Both tunnel and shaft are working in high-grade ore bodies of unknown size.

The Harrington-Hickory group has 25 full and fractional claims, with about 12,000′ of development work. There are 40 pits and shafts, all bottomed in ore, the two deepest shafts being about 400′ each, with a new 3-compartment main working shaft sinking. This property shows numerous fissure veins, intersected by cross veins, both approximately vertical, and furthermore has a series of bedded veins, giving three separate systems of ore bodies, the bedded veins having a dip of approximately 30° to 35°. These ores average only 2% to 3% copper, but carry 25% to 50% lead, $1 gold and 50 oz. silver per ton. Ore is being blocked out for stoping on this property.

The Vicksburg group has 4 claims, showing 3 vertical fissures, 2′ to 20′ wide, with mineralized cross-veins at right angles, and was formerly worked for gold. There are numerous shafts and pits of 10′ to 90′, all bottomed in ore. A 2-compartment working shaft with gasoline hoist was started September, 1902, and ore is being blocked out for stoping.

The Hoosier Boy group has 10 claims, with a 250′ vertical shaft on a fissure vein in limestone, with two short levels opened, and has produced about $150,000 in values from auriferous and argentiferous copper-lead ore bodies.

The Larkspur group of 8 claims shows a mineralized zone of 60′ to 75′ wide, between granite and limestone walls. The values are apparently carried in bunches of high-grade ore occurring irregularly.

The Copperfield group has 17 undeveloped claims lying between the O. K. and Old Hickory mines. The Apex group has 4 claims adjoining the Old Hickory, and gives good surface showings, but has practically no development. Ore is being blocked out in the Ben Harrison and Montreal claims.

Steam, gasoline and electric power are used. The company owns an undeveloped water power on the Beaver river, about 35 miles from the mine, and contemplates developing 2,000 h. p. and transmitting same to the mine and smelter, at a cost of about $100,000 for the installation.

A smelter is being built at Lewisville, 3 to 8 miles from the various mines, and ore will be delivered by rail. The smelter building is of steel frame on stone foundations, and of size to accommodate furnaces of 1,200 tons daily capacity, which the company hopes to have in operation at the close of 1903. Two 250-ton copper furnaces and one 100-ton lead furnace are to be blown in early in 1903. The furnaces will have Nesmith hot-blast stoves, heating the air going to the furnaces to 800° Fahrenheit before entering the tuyeres. A townsite called Lewisville has been platted by the company, and a big pumping plant is to be installed, to supply water for the smelter and townsite. The mines and smelter are served by the Oregon Short Line Railway.

The Majestic company has produced upwards of 1,000,000 pounds of copper from the O. K. ores shipped to custom smelters. It is not possible that such sensational amounts of copper will be secured by the company when its own smelter goes into blast, but it does seem possible that returns of 10% to 15% copper can be secured from ores supplied in sufficient quantities to feed the smelter to nearly or quite its capacity of 500 tons daily. It is probable that ore can be mined and smelted for a cost of $5 per ton. The president estimates that the mine will make copper for less than nothing, but in actual practice this is not likely to occur. The mine, however, should be able to make a remarkably low record in the cost of its production and the president's estimate of an output of 20,000,000 pounds of refined copper for 1903 does not seem unduly large. The company's officers stand well, its finances are in good condition, and as the property is one of exceptional merit, it will probably take ultimate rank among the big copper mines of the United States.

**MALACHITE COPPER-GOLD CO. CALIFORNIA.**

Office: 209 Homer Laughlin Bldg., Los Angeles, Cal. Mine office: Daggett, San Bernardino Co., Cal. Organized under laws of South Dakota, with capitalization $1,000,000, shares $1 par. S. A. Barrett, president; Dr. A. P. Hays, vice-president; Jos. B. Cook, secretary; W. E. Steadman, superintendent. Lands, 5 claims, area 100 acres, in the Ord district of San Bernardino Co. Has 165′ shaft and a 34′ vein, carrying an 8′ pay streak assaying 7.5% copper and $3 gold per ton. No returns secured.

**MALAGON GROUP. SPAIN.**

Mine office: Puebla de Guzman, Huelva, Spain. Owned by C. & J. Sundheim. Wm. Guthrie Bowie, manager. Property is a group of concessions from the government. There are many old workings and excellent outcrops. Owners contemplate giving the property a thorough test.

**MALONEY-BLUE LEAD COPPER MINING CO. SOUTH DAKOTA.**

Mine office: Sheridan, Pennington Co., South Dakota. Capitalization, $3,000,000. R. M. Maloney, general manager. Property carries gold, nickel and copper, latter in small percentages. Company plans building a smelter.

**MAMMOTH MINE. ARIZONA.**

At Dragoon, Cochise Co., Ariz. S. S. Campbell, superintendent. Property is opened by shafts. Has steam and gasoline power and employs a small force.

**MAMMOTH MINE.** **CALIFORNIA.**

Near Kennett, Shasta Co., Cal. John Fillins, superintendent. Lands, 12 claims, area 240 acres, and a patented section of 640 acres, in the Backbone district, 4 miles northwest of Kennett. Has about 1,500′ of tunnels, showing a large ore body of medium grade.

**MAMMOTH COPPER CO.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Location of property, if any, unknown. Promoters are widely and unfavorably known. See Excelsior Mining Co.

**MAMMOTH COPPER MINING CO.** **WYOMING.**

Mine office: Saratoga, Carbon Co., Wyo. A. G. Epperson, superintendent. Was working a small force on development at last accounts.

**MAMMOTH MINING CO.** **UTAH.**

Mine office: Mammoth, Juab Co., Utah. Samuel McIntyre, Jr., superintendent. Is a gold-silver-lead-copper property, the copper being secured as a by-product. Has steam power and a 60-stamp mill; employs several hundred men.

**MAMMOTH TUNNEL & MINING CO.** **COLORADO.**

Office: 403-331 Fourth Ave., Pittsburg, Pa. Mine office: Silverton, San Juan Co., Colo. Advertises that prospectus and particulars will be furnished on application, but has not supplied same for this book, in response to requests.

**MAMMOTH HILL GROUP.** **ARIZONA.**

At Safford, Graham Co., Ariz. E. F. Buss, superintendent. Copper and silver ores are being opened by a shaft.

**MAMMOTH LODES MINING CO.** **BRITISH COLUMBIA.**

An Oregon corporation, operating the Colorado group of claims in the Cascade Mountains, Yale & Cariboo district, British Columbia. Veins are said to run from 40′ to 250′ in width, and to be traceable for more than two miles. Is asserted that smelting tests show 15% to 20% copper and $12 gold per ton. These claims probably will be subject to revision later.

**MANASSAS GAP COPPER MINES.** **VIRGINIA.**

It is expected that the Carter Copper Co. will change its name to this title, in February, 1903.

**MANHATTAN GROUP.** **ARIZONA.**

At Cave Creek, Arizona. Wm. Linville, agent. Supposed to be prospecting with a small force.

**MANHATTAN COPPER MINING CO.** **ARIZONA.**

Was consolidated with the Troy, under name of Troy-Manhattan Copper Company, in 1902.

**MANHATTAN COPPER & GOLD MINING CO.** **NEVADA.**

Incorporated in Colorado, July, 1902, with capitalization $500,000, to operate in Lincoln Co., Nevada, and elsewhere. No returns secured.

**MANSFELD'SCHE KUPFERSCHIEFERBAUENDE GEWERKSCHAFT.** **GERMANY.**

Mine office: Eisleben, Prussian Saxony, Germany. Organized 1852

This is one of the world's half-dozen largest copper mines, and produced 19,649 tons of copper in 1901. Mine was opened A. D. 1199, and has worked continuously since then, barring occasional interruptions from war. The ore is a slightly argentiferous chalcopyrite, associated with cobalt and nickel ores, and occurs as speise, being sprinkled as dust and fine grains through the kupferschiefer, which is a fine-grained sandstone. There are also carbonate and sulphide ores in an arenaceous shale lying just below the kupferschiefer. The main cupriferous bed is nearly horizontal, and is but two to three feet thick, though covering nearly 200 square miles, and miners work on their sides, bellies or backs, as in coal mines. Nearly 10,000 men are employed, directly and indirectly, by this great corporation. Sundry coal strata are found above the cupriferous beds, and coal and copper ore are sometimes mined through the same shafts. The smelter has Steinbeck's circular multiple-hearth automatic pyritic calciners, which use no carbonaceous fuel, except in the preliminary charges, the oxidation of the sulphur in the ore furnishing the necessary heat. The copper secured averages about 2.5%, and the blister copper turned out by the smelter carries nearly 0.5% silver.

**MARAVILIA COPPER CO.** **ARIZONA.**

Mine office: Solomonville, Graham Co., Arizona. Jas. H. Knowles, manager. Is developing the Lone Star group, about 20 miles southwest of Clifton. Mine is opened by shafts and has gasoline hoists, employing about 25 men.

**MARBLE BAY MINES.** **BRITISH COLUMBIA.**

Mine office: Van Ada, Texada Island, B. C. J. J. Palmer, superintendent. A small but complete machinery equipment, including a 150-ton concentrator, was installed in 1901, in which year 5,580 tons of ore were shipped, said to be of good grade. Is opened by a vertical shaft and has considerable underground development. Employed about 70 men, at last accounts.

**MARGUERITA MINE.** **CALIFORNIA.**

An old property in the vicinity of Almaden, Cal. Operated circa 1865; reopening is being considered.

**MARICOPA COPPER MINES CO.** **ARIZONA.**

Letter addressed to company's office at Wickenburg, Maricopa Co., Arizona, was forwarded to Morristown, Ariz., and thence returned, unclaimed, in October, 1902.

**MARITIME COPPER & REDUCTION CO.** **NEW BRUNSWICK.**

Mine office: Goose Creek, N. B. Was worked many years ago, and is being reopened by tunnel, 20′ above sea level, which is to be driven 1,500′, across several cupriferous veins. A low-grade ore deposit is to be quarried, from the face of the cliff. Company is erecting boarding houses, stables and mine buildings, and contemplates the erection of a smelter.

**MARKEEN COPPER CO.** **ARIZONA.**

Office: 66 Broadway, New York. Mine office: Clifton, Graham Co., Ariz. Organized 1898, under laws of West Virginia, with capitalization $1,000,000, shares $10 par. Thos. A. Lee, president and treasurer; Alfred

P. Stevenson, vice-president; Thos. E. Warman, secretary; Leopold Balbach, general manager. Lands, 370 acres, in the Greenlee district of Graham Co. Ore measures said to be extensive, having low-grade copper carrying gold and silver values. No returns secured.

**MARQUETTE & ARIZONA MINING CO. ARIZONA.**

Office: Marquette, Mich. Mine office: Bisbee, Cochise Co., Ariz. Organized late in 1902. Jos. J. Wirtz, acting secretary. Lands, 37 claims, area 340 acres, in the Warren district of Cochise Co. Company contemplates doing considerable development work during 1903.

**MARSHALL & McCLURE GROUP. ARIZONA.**

Supposed to be developing, with small force, near Williams, Coconino Co., Arizona.

**MARTHA WASHINGTON MINE. UTAH.**

A silver mine at Silver City, Utah, ore from which carries 2% to 3% copper.

**MASHELL COPPER MINING & REDUCTION CO. WASHINGTON.**

Office: 437 Banigan Bldg., Providence, R. I. Mine office: Etonville, Pierce Co., Wash. C. J. McCormick, president; J. M. Mansfield, secretary and treasurer. Lands are about 3 miles from Tacoma, Wash. Opening work was begun in 1900, showing a number of small veins, all carrying good assay values, especially in gold. Company is understood to have a reduction plant on the ground for installation, but no work was in progress at last accounts.

**MASON & BARRY, LTD. PORTUGAL.**

Offices: 87, Cannon St., London, E. C., Eng. Sir Francis Tress Barry, Bart., chairman; J. F. Mason, deputy chairman; E. O. Barry, secretary. Registered, June 2, 1892. Capital, nominal, £210,000; issued £185,172. Present capital was reduced from £1,500,000 by returning four £1 payments in cash to shareholders. Net profits in 1901 were £119,225, with dividend disbursements of £115,733. Company is a large operator in Portugal, its principal property being the San Domingos mine, opened in 1859. Annual production of copper is about 8,000,000 pounds, in addition to which large quantities of pyritous ore are burned for sulphur.

**MASS CONSOLIDATED MINING CO. MICHIGAN.**

Office: 16 State St., Boston, Mass. Mine office: Mass City, Ontonagon Co., Mich. Mill office: Keweenaw Bay, Mich. Mine is active, working about 200 men and 35 power drills. Production for 1901 was about 1,000,000 lbs., and 1902 output was approximately 3,000,000 lbs. refined copper. Organized 1899, under Michigan laws, with capitalization $2,500,000, in 100,000 shares, par $25, and $17 paid in. Annual meeting, second Thursday of March. Chas. A. Lamb, president; L. D. Whittemore, vice-president; F. W. Hunton, secretary and treasurer; directors are preceding officers, A. B. Turner, F. H. Begole, C. H. Bennett, B. T. Cable, David W. Farquhar, and J. Walter Davis. Jas. M. Wilcox, mine superintendent; Chas. H. Krause, mill and surface superintendent; W. A. Brown, clerk and purchasing agent; E. V. Palmer, mining engineer; Thos. Hall, mining captain; Samuel V. Rawlins, master mechanic.

On Jan. 1, 1902, the company had a balance of $96,880.72, and an assessment of $2 per share was levied, payable half in December, 1902, and half in April, 1903. Proceeds of the last assessment will be used to pay off a floating debt incurred for mine equipment and mill, and to provide additional underground development. Total income for 1901, including interest and assessments, was $576,500.24, and expenditures were $577,603.90, of which $308,433.34 was on construction account and $3,134.69 was for real estate and townsite improvements, leaving actual operating expenses of $266,035.87.

The mineral lands comprise a very irregular but fairly compact tract of a trifle more than 2,400 acres, all on the Keweenawan copper belt, lying in Sections 33, 34 and 35, Town 51 North, Range 38 West, and in Section 1, Town 50 North, Range 39 West. Lands are bounded on the north by the Union Copper Land & Mining Company, the Adventure and farm lands; on the east by the Adventure, Toltec and Evergreen; on the south by the Flint Steel and Knowlton mine of the Adventure, and on the west by the Flint Steel, Adventure and St. Mary's Mineral Land Co. The Mass Consolidated includes three old mines, the Ridge, Mass and Ogima, and two old prospects, the Merrimac and Hazard, the joint production of which, under previous managements, was 5,565 tons, 1,023 lbs. refined copper. Each of the three old mines had antiquated mills, which were torn down by the present management. The Ridge made 2,567 tons, 449 lbs. of copper, and paid dividends of $100,000, the mine having been opened 1850 and closed 1874. The old Mass mine was opened 1856 and worked intermittently until 1886, securing a total output of 2,507 tons, 266 lbs. of copper. The Ogima was opened 1860 and closed 1868, making only 491 tons, 308 lbs. copper. The Merrimac and Hazard were early-day explorations, without production. These five properties are described in detail in the 1902 edition of this work.

The Mass has six of the seven cupriferous amygdaloids of the Evergreen belt; these averaging 10′, but varying greatly in width from point to point. The entire mineral formation is much broken, as is the case on the Adventure lands adjoining. There is a sharp bend in the outcrop of the Evergreen belt on the Mass lands, the strike varying from N. 32° E. at the northern end to N. 37° E. at the south. The dip of the lodes varies from 38° at the Ridge to 47° at the old Mass mine. The six lodes of the Mass Consolidated are as follows, from north to south:

(1). Knowlton. Carries heavy copper and stamp rock, but has not been opened extensively.

(2). Mass. Lies 140′ south of the Knowlton. Carries both heavy copper and stamp rock, rather sparingly.

(3). North Butler. Lies about 75′ south of the Mass bed. Opened in 1901 by a crosscut; seems fairly mineralized and exceptionally wide where opened.

(4). Butler. About 200′ south of the North Butler. Is a strong bed, running 12′ to 30′ wide; is very bunchy, carrying mainly stamp copper, with some mass.

(5). Ogima. About 100′ south of the Butler. Is mainly a stamp lode, with some barrel work and occasional masses. Runs 10′ to 25′ in width and shows little good ground in the limited amount of openings secured.

(6). Evergreen, or Ridge. Lies about 250′ south of the Ogima. Is the best lode of the property. Runs 4′ to 40′ wide, and is usually richest where of good width. Is very bunchy, but shows some excellent stopes, that yield heavy copper and stamp rock in good quantity.

The system of parallel lodes containing workable rock is peculiar to the Evergreen belt, among mines of the Lake Superior district, and only the Adventure and Mass mines are now working on this belt. The Mass has openings on all of its copper-bearing beds, and rock is hoisted through the nearest shaft, communication between lodes being afforded by crosscuts on various levels. The Mass has the outcrop of these lodes for about 1½ miles, or a total of 7½ miles for all six beds.

"A" shaft was formerly known as the Ridge; has 3 compartments, with double skipway, and sends its rock over a 900′ trestle to the rockhouse at "B." Is down to the 11th level on the Evergreen lode and is connected with the Butler lode by crosscuts on the 6th, 7th and 8th levels. The Evergreen lode runs narrower here than in "B" shaft, averaging only 8′ to 10′ wide, but showing much rock of excellent grade.

"B" shaft is old No. 3 Ridge cut down to 2-compartment size, retimbered and deepened four lifts, to the 11th level. This shaft has some fine stopes 20′ to 25′ wide, producing much mass and barrel copper. The lode is strong, with plainly defined walls, and has a dip of 43°. There are connections with the Butler lode on the 4th, 6th and 7th levels. The shaft-rockhouse is of wood, iron-sheathed, 48x65′ and 80′ high, fitted with steam hammers, two 22x28″ Blake crushers and a 12x24″ Nordberg engine, with room for additional crushers when needed.

"A" and "B" shafts are operated from a central engine house 44x150′, of wood, iron-sheathed. The Allis-Chalmers hoist is a 24x48″ duplex, with 10′ drums having 11′ faces, grooved for 1¼″ cable, and good for a half-mile depth. The hoist operates two six-ton skips, in counterbalance, one in each shaft. The engine house also covers boilers, compressors and electric machinery. There are two 250-h. p. Stirling water-tube boilers; a fine two-stage cross-compound Rand air compressor of 50-drill capacity and a 75-kilowatt dynamo that furnishes electric lights for the various mine buildings.

"C" shaft, started by the Ogima company some 40 years ago, has been cut down to 3-compartment size and deepened to 400′. This shaft is about a quarter mile southwest of "B," and by virtue of its location on the Butler lode can quickly reach the parallel copper-bearing beds on either side, and should become a large producer when developed, as the trams will be shorter than at "A" and "B." The limited amount of development secured at this shaft shows good ground.

"D" shaft is in embryo, its tentative site being about 2,100′ southwest of of "C."

There are a number of old shafts in the old mines and prospects, some of which eventually may be straightened, enlarged and deepened into modern working shafts. The main shaft of the old Mass mine proper is 450′ deep and has seven levels opened on the Knowlton lode. This was pumped out late in 1901, and the showing pronounced satisfactory. The Ogima lode has been opened by crosscuts from "A" and "B" shafts at several points, showing some good though bunchy ground.

In addition to the usual mine buildings the Mass has about 50 dwellings, some new, but mostly old buildings thoroughly remodeled. The company also has a townsite, Mass City, which is the terminus of the Mineral Ridge R. R. and a station on the C. M. & St. P. Ry. This town has a large number of business houses, a bank, newspaper, hotels, etc., and is much more than an ordinary mining location. The growth of the town has been marked, and the realty holdings of the Mass company therein are of large and increasing value.

The Mass mill is at Keweenaw Bay, on an arm of Lake Superior and at the junction of the Mineral Range and Duluth, South Shore & Atlantic railways, 16 miles south of Houghton and 34 miles northeast of the mine. There is ample sandroom, deep water and immunity from the heavy seas that preclude the making of harbors at the new millsites on the shore of Lake Superior in the Redridge district. The mill is 90x210′, of steel on stone foundations, built by the Wisconsin Bridge & Iron Co. in 1900–1901, and has two stamps, with mortars supplied with automatic hydraulic cleaning devices, and two Wilfley tables for each head. Adjoining is the boiler house, 36x60′, of wood with iron sheathing and truss roof, having two 225-h. p. Stirling boilers. Ashes and cinders are washed into the lake by water, through a chute. The pumphouse is 40x70′, housing a 16,000,000-gallon vertical Nordberg pump. Underneath is the well, 12x30′, with its bottom 6′ 6″ below mean water level, connected with a tunnel running 300′ under the bed of the bay to the intake.

A wharf, 1,000′ long, which also serves as a breakwater, has 18′ of clear water at its end. This has three towers, with derricks to unload coal vessels at the rate of 900 tons daily. Coal is taken in 3-ton cars from the wharf to the mill and railroad track, over a 1,500′ trestle, by a hoist with 14x20″ cylinders. There is storage capacity for 20,000 tons of coal. There is also a warehouse 30x40′, with office in front, blacksmith and machine shops, etc. The company has about a dozen dwellings near the mill, and a townsite has been platted, on which several business buildings and a number of private dwellings have been erected, the town having had a thriving growth.

The first stamp at the mill was started August, 1901, and the second in March, 1902. The Mass rock is very refractory in milling, giving a daily capacity of only about 400 tons per head. It was soon found impracticable to supply selected rock for two heads from the mine openings, and the heads were run days only until the fall of 1902, since when they have been running about three-quarters time, treating 500 to 600 tons daily. During the summer and fall of 1902 the mine has been making 150 to 180 tons of mineral per month, from 12,000 to 13,000 tons of rock. A little less than half of the product comes as mass and barrel copper that does not see the mill at all. The returns from the mill are very small. It is probable that the rock stamped at the Mass mill is running 11 to 14 pounds of ingot per ton, or at about the same rate as the Atlantic or Isle Royale. This would be most discouraging and would surely spell disaster were it not for the heavy copper, which is nearly half of the total product secured. The Atlantic has almost no heavy copper and the Isle Royale gets only about 15% of its product in mass and barrel work. With the Mass from one-third to one-half the monthly production comes from the rockhouses. The product of the Mass was about 155 tons of mineral in September, and 175 tons in October, 1902, secured from 25,000 tons of rock. Owing to the large proportion of heavy copper the mineral runs unusually high in copper, 80% probably being a fair estimate. The figures for these two months give 1.32% mineral, or, figuring mineral as 80% fine, 1.056% ingot copper, equal to a little more than 21 pounds per ton. This is not as large as was hoped, but is sufficient to let the mine earn a profit, when worked upon a large scale, with the many economies that can be effected by more extensive operations.

The Evergreen lode has always been noted for its richness in silver. The metal occurs native, with the copper, and more or less is picked out by hand at the mine and mill. The larger pieces rarely see the company's officials, remaining with the miners that find them. The great bulk of the silver is in fine grains that pass unobserved into the mineral, at the mill. Two sample cargoes of mineral sent to Chicago for electrolytic refining in the winter of 1901–1902 gave returns of 96 oz. and 157 oz. silver per ton of refined copper, respectively. The lowest returns equalled about $40 per ton silver values. Electrolytic refining would cost probably ¾ cent per pound, and the copper would sell at reduced price, as electrolytic and not lake, making a net charge of not quite 1 cent per pound, with $20 per ton, or one cent per pound, net gain from silver. The matter of saving silver values has been given consideration by the Mass management, but nothing has been decided upon. Possibly a David selecteur would save 75% of the silver values, without lowering the product of refined copper to electrolytic grade. There are as capable smelting men in the lake district as elsewhere, and there seems no particular reason why at least half and very possibly three-fourths of the silver values should not be saved in the smelters, yet permit the ingots to go out as best refined lake, in cases where the silver is carried in such quantities as to justify the extra labor and cost that its conservation would entail.

**MASSEY STATION MINING CO.** **ONTARIO.**

Office: 7 Wall St., New York. Mine office: Massey Station, Algoma, Ont. Employs 40 men. Organized 1900, under laws of Ontario, with capitalization $1,000,000, shares $100 par, non-assessable. J. J. Thompson, president; Robt. McKay, secretary; Jos. Errington, general manager; R. C. Barclay, clerk and purchasing agent; Jas. Summers, mining captain. Lands, 640 acres, also 160 acres miscellaneous lands, in Salter Twp., Algoma district, Ontario, showing 5 lenses, of which 2 are being developed, these having an average width of 10′, and opened to length of 358′ and depth of 370′, carrying 5% copper, with traces of gold and silver. Main shaft, 370′, with 4 levels, 80′ apart, and about 200′ of drifting on each level. Estimated ore blocked out for stoping, 50,000 tons. Steam plant; 6-drill Ingersoll-Sergeant air compressor; 6½x8" and 10x12" Lidgerwood hoists. Ore is shipped 50 miles to the smelter at Copper Cliff, where it is used as a flux, in reducing the nickel-copper ores of the Canadian Copper Co. Sinking and drifting will be continued during 1903, and company contemplates building a smelter at or near the mine.

**MAY DAY MINING CO.** **UTAH.**

Mine office: Eureka, Juab Co., Utah. J. A. Hunt, superintendent. Is a gold and silver mine, making some copper as a by-product. Has a steam plant and concentrator, and employs 50 to 75 men.

**MAYFLOWER MINING CO.** **MICHIGAN.**

Office: 60 State St., Boston, Mass. Mine office: Calumet, Houghton Co., Mich. Organized 1899, under laws of Michigan, with capitalization $2,500,000, in 100,000 shares, par $25, and $8 paid in. Annual meeting, third Wednesday in March. Old Colony Trust Co., registrar. H. F. Fay, president; W. B. Mosman, secretary and treasurer; Jas. Chynoweth, superintendent; H. F. Fay, W. B. Mosman, John C. Watson, Stephen R. Dow, Manning Emery and Jas. Chynoweth, directors.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $300,000.00 |
| Amount paid in by conveyance of property to company | 500,000.00 |
| Entire amount invested in real estate | 540,000.00 |
| Amount of personal estate | 125,256.68 |

Mineral lands, 840 acres, in Sections 7 and 8, T. 56 N., R. 32 W., Houghton Co., Mich. The Kearsarge mine lies to the north, Old Colony to the south and the South Kearsarge and Wolverine mines to the west. Company also owns a millsite on Torch Lake. There is a close connection, in management and location, between the Mayflower and Old Colony. Exploratory work on the Mayflower was begun 1899, starting with trenching, by which four mineral beds were cut, followed by shaft sinking. A 160' shaft on what is supposed to be the Isle Royale amygdaloid shows a bunchy lode, 10' to 12' wide, carrying more or less copper in a 2' streak next the hanging wall. Several hundred feet of drifting was done on this lode. The "sandstone" shaft was sunk near the eastern sandstone, in a soft and badly broken amygdaloid, and was abandoned at the depth of 62 feet. All of the Keweenawan strata near the eastern sandstone are badly disturbed, conditions becoming more settled to the westward.

The "Faull" shaft, near the Old Colony line, is 380' deep, with considerable drifting on the first and second levels, and has a crosscut that opens parallel cupriferous amygdaloid beds. This shaft shows occasional patches of copper, but nothing of much promise. Present developments are confined to a lode found accidentally in 1901, when a miner in digging out an old stump for kindling wood saw native copper below the roots. This lode is about 15' wide and has a shaft about 550' deep, which starts from surface on one amygdaloid and at a depth of 425' runs into a parallel amygdaloid lying 90' eastward of the original bed, caused by the lodes pitching at a very sharp angle from surface, but flattening at little depth. A drift to northward is running on the 100′ level. The lode is strong, but carries but little copper, though showing fairly good ground in patches. The hoist is good for 600′ depth. Surface improvements include boiler and compressor house, etc.

**MAZAPIL COPPER CO., LTD.** **MEXICO.**

Offices: 47, Peter St., Manchester, Eng. Capitalized at £200,000, shares £10 par. Supposed to own copper mines or copper mining lands in the state of Zacatecas, Mexico, but no returns secured.

**MEADOW MINING CO.** **MICHIGAN.**

Office: 50 State St., Boston, Mass. Mine office: Copper Falls, Keweenaw Co., Mich. Organized 1898, under Michigan laws, with capitalization $1,500,000, shares, $25 par. W. F. Fitzgerald, president; John Brooks, secretary and treasurer; Wesley Clark, agent. Lands, 364 acres, adjoining the Humboldt and Phœnix mines. Has been slightly prospected, but was never a producer.

**MECHAN HERMANOS.** **MEXICO.**

Mine office: Viesca, Coahuila, Mex. Operate the Santa Maria copper mine, opened by shafts and tunnels, and employ about 100 men.

**MEGUNTICOOK GOLD & COPPER MINING CO.** **WYOMING.**

Office: apparently at Lake City, Colo. Owners, principally in Maine, Vermont and New Hampshire. J. G. Dawson, local director, Lake City, Colo. Affairs are apparently considerably tangled. Property is supposed to be in or near the Encampment district of Wyoming.

**MELEZER MINING CO.** **MEXICO.**

Mine office: Pesqueria, Sonora, Mexico. J. J. Hardwick, superintendent. Ores carry copper and gold. Mine is opened by shafts and tunnels and equipped with steam, water power and electricity. Is said to have a 200-ton smelter, and to be employing 250 men, but no returns have been secured.

**MELKEDALEN COPPER MINES.** **NORWAY.**

Offices: 22, Leadenhall St., London, E. C., Eng. G. B. Mee, chairman; W. A. Stearns, secretary. Capital, nominal, £120,000. Mines are at Evenaes, Ofoten Fjord, Norway, in the Röros district, and supposed to be idle, but no returns secured.

**MEMPHREMAGOG MINING CO.** **QUEBEC.**

Address: care of G. E. Smith, Sherbrooke, Que. Company owns the Smith mine, near Lake Memphremagog, at Bolton Centre, Brome Co., Quebec. No returns secured; property probably idle.

**MENDOCINO COPPER KING MINING CO.** **CALIFORNIA.**

Mine office: Yorkville, Mendocino Co., Cal. Supposed to be opening a copper prospect by tunnel, with small force.

**MENDOTA MINE.** **MICHIGAN.**

An extensive tract of mineral land in the northeastern part of Keweenaw Co., Michigan, on which considerable work has been done from time to time, but idle for many years. Fully described in 1902 edition.

**MENDOTA MINE.** **NEVADA.**

Mine office: Bullion, Elko Co., Nevada. J. T. Donnellen, superintendent. Ores show silver, lead and copper values. No returns secured.

**MENLO PARK COPPER MINING CO., LTD.** **NEW JERSEY.**

Incorporated with capitalization $5,000, November, 1902, by Christian C. Keller, et al., of Camden, N. J. No returns secured.

**LA SOCIEDAD ANOMINA COBRES DE MENORCA.** **SPAIN.**

Offices: Gran Via 32, Bilbao, Spain. Is employing 80 men. Organized October, 1901, under laws of Spain, with capitalization 2,000,000 pesetas, in 8,000 shares of 250 pesetas, 35% paid in. Cirilo de Gana, president; Fernando Olascoaga, vice-president; Manuel de Ozamir, secretary; Esteban Puego, superintendent; Baron de Prisbuer, purchasing agent. Mining lands, 411 hectares, near Mercadal, district of Mahon, Island of Minorca, Balearic Islands. Property is in the central part of the island, at the foot of Mount Toro, and development work is now in active progress.

**MERAKER MINES.** **NORWAY.**

In the Röros district, south of Trondhjem, Norway. Include the Stavanger and Vigsnes mines, which were 2,389′ deep and made 960 long tons refined copper in 1895.

**MERRISSKI WORKS.** **RUSSIA.**

Address: care of R. A. Richner, Batum, Russia. Mines are in the government of Kutais, in the Caucasus. Production was 4,544 poods in 1899.

**METHOW GOLD & COPPER MINING CO.** **WASHINGTON.**

Address: Lock box 1883, Spokane, Wash. D. R. Ostrander, president. Has a group of claims on McKinney Mountain, Okanogan Co., Wash. Principal development work has been done on an 8′ vein carrying a 2′ to 4′ pay streak. Ore, mainly chalcopyrite, assays 4% to 25% copper and 2 to 20 oz. silver per ton. Development is in progress.

**METROPOLITAN MINING CO.** **WASHINGTON.**

Mine office: Berlin, King Co., Wash. H. J. McIntosh, superintendent. Ores, carrying gold, silver and copper, are being developed by a tunnel; has water power and employs 15 to 20 men.

**MEXICAN COPPER CO.** **ARIZONA.**

Mine office: Martinez, Yavapai Co., Ariz. E. S. Yankee, superintendent. Ore body carries copper, silver and gold, and is opened by shaft; employs 12 to 15 men.

**MEXICAN COPPER CO.** **MEXICO.**

Mine office: Salinas, San Luis Potosi, Mexico. R. B. Watson, manager. Produces silver, lead and copper; mine is opened by shafts, equipped with steam and gasoline power, and has a smelter. Employs several hundred men.

**MEXICAN COPPER SYNDICATE, LTD.**

Offices: 8, Eastcheap, London, E. C., Eng. G. Mountier, secretary. Cannot be learned that company is possessed of mines in Mexico or elsewhere.

**COMPANIA METALURGICA MEXICANA.** **MEXICO.**

Is said to be operating a copper mine near Sierra Mojada, Coahuila, Mexico, but no returns secured.

**MEXICAN-ARIZONA MINING CO.** **ARIZONA.**

Mine office: Clifton, Graham Co., Arizona. L. A. Dunham, superintendent. Said to be developing a copper ore body by tunnel, with steam power, and to be working a fair force. No returns secured.

**MEXICO MINE.** **MEXICO.**

At Sabinal, Chihuahua, Mexico. Uriatta Bros., owners. Ores carry silver, copper and lead. Mine has steam power and was working a small force at last accounts.

**MEXICOLA GOLD-COPPER MINING CO.** **COLORADO.**

Office: Cripple Creek, Colo. M. J. Maynard, president; T. J. Hines, secretary. Reorganized under South Dakota laws, with capitalization $200,000. Company has three gold claims, north of Rhyolite Mountain, and 9 copper claims, area 78 acres, in the Little Badger district, near Howard, Colo. No returns secured.

**MICHIGAN COPPER MINING CO.** **MICHIGAN.**

Office: 11-13 William St., New York. Mine office: Rockland, Ontonagon Co., Mich. Organized Jan. 5, 1899, under laws of Michigan, with capitalization $2,500,000, in 100,000 shares, par $25, with $13 paid in. Last assessment, $2 per share, was levied May, 1902. Annual meeting, first Tuesday in May. John Stanton, president; Joseph E. Gay, vice-president; J. Wheeler Hardley, secretary; John R. Stanton, treasurer; John Stanton, Jos. E. Gay, J. W. Hardley, John R. Stanton and Alfred M. Low, directors; Samuel Brady, superintendent; J. C. Thomas, mining captain. American Loan & Trust Co., Boston, transfer agent; Old Colony Trust Co., Boston, registrar.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,000,000.00 |
| Amount paid in by conveyance of property to company | 670,350.00 |
| Entire amount invested in real estate | 727,119.19 |
| Amount of personal estate | 31,182.07 |
| Amount of unsecured or floating debt | 17,209.99 |

Expenditures for 1901 were $113,325.16. Total expenditures to close of 1901 aggregated $1,144,275.19, including $727,119.19 paid for mining lands and sundry real estate, and $417,156.00 expended for equipment, mining costs and all miscellaneous charges.

The Michigan company owns upwards of 5,000 acres of mineral or surface rights, or both. The lands are in Sections 1, 2, 3, 9, 10, 11, 13, 14, 15, 16, 17, 21, 22, 23, 24, 25, 26 and 27, Town 50 North, Range 30 West. The main tract is 3 miles east and west, by 4½ miles north and south, in addition to which there are four scattering tracts to the westward, one of 40, two of 80 and one of 160 acres, carrying the outcrop of the Calico amygdaloid. The Michigan tract includes the old Minnesota, Rockland and Superior mines. The Superior made 283 tons, 1,331 lbs. refined copper, 1856-1869 and 1876-79. The Rockland lies next east of the Minnesota and was operated 1853-1870, with a total production of 3,105 tons, 309 lbs. of refined copper, secured from the Minnesota contact vein, which averaged about 2′ width and carried considerable silver.

The old Minnesota mine, which is the scene of present operations, was one of the most famous of early-day Lake Superior copper properties. It was opened circa 1847, and closed 1870, paying dividends of $1,820,000 from 17,352 tons, 668 lbs. of copper produced. Though not the largest, this was unquestionably the richest copper mine that has ever secured any considerable production. The masses of copper taken from this mine were of almost fabulous size, the largest, found in 1856, measuring 12½x18½x46′, weighing 527 short tons and requiring the work of 20 men for 15 months in cutting it into masses small enough for hoisting. The mine was discovered by the finding of prehistoric pits, in one of which was a 6-ton mass of virgin metal raised on skids, and on top of which grew a hemlock tree having nearly 400 rings of annual growth—a tree that was a sturdy sapling long before Columbus first sailed from Palos, in 1492.

The Minnesota was opened on a contact vein having an amygdaloid hanging and conglomerate footwall, both of which were impregnated with copper near the contact. Miners called the Minnesota a conglomerate mine, because more copper was found in the footwall than in the denser amygdaloid hanging wall. The richest ground occurred near the "counter vein," a transverse fissure. The gangue of the contact vein was mainly quartz, epidote and calcite. The Minnesota had a 40-ton stampmill with gravity stamps, but the bulk of the mine's production was from the large and small masses and the smaller chunks of native metal called barrel work. The old Minnesota company struck low prices for copper, a pinching of the vein and the necessity for more powerful hoists, simultaneously, in 1870, and gave up the struggle. The openings above the adit level, being free from water, were worked by tributors for years afterward, and yielded hundreds of tons of mass and barrel copper. This affords ample evidence that an immense amount of heavy copper remains in the lower stopes, then inaccessible to tributors because filled with water, in addition to which practically every old stope in the mine, from top to bottom, will yield its quota of stamp rock, untouched in the days when nothing under 3% rock would pay for milling. The Minnesota had 10 shafts, the deepest about 1,100′. Four central shafts were sunk from surface on the North Minnesota fissure, which joined the contact at about 300′ depth.

The present company is confining work to the neighborhood of the old Minnesota, which is being reopened by making a new mine parallel with it, while apparently there is a third mine between the new and the old. The Calico amygdaloid bed outcrops 140′ north of the Minnesota contact vein and a few feet north of the North Minnesota fissure, on which the central shafts of the old Minnesota were started. Just as the North Minnesota fissure ran diagonally between the parallel amygdaloid and contact vein, so at least one other branch vein runs from the Calico to the contact, at greater depth, and this is rich in masses of copper of great size. In addition to the Calico lode, Minnesota contact, North contact and branch vein, the Michigan tract carries the Knowlton, Mass, Ogima, South Amygdaloid and an unnamed amygdaloid yet farther south, these latter belonging to the Evergreen belt worked a few miles to the northeastward by the Mass and Adventure mines. The Knowlton, or northernmost of the Evergreen series of parallel lodes, is about 1,000′

south of the old Minnesota shafts, and a 7′ amygdaloid, supposed to be the Butler, has been opened to some extent in Peninsula Bluff, 2,000′ south of "B" shaft, this showing heavy copper and stamp rock. There are three old shafts on the Butler lode, also an adit cutting several parallel cupriferous beds. There are also copper-bearing amygdaloid outcrops north of the Calico bed, on which no work has been done.

The shafts sunk by the present company are in the Calico lode, so called from the patchwork of bright colors shown by the rock. This bed parallels the contact vein, and the old Minnesota has been reopened by crosscuts, simultaneously with the development of a new ore body on the Calico itself, which has been traced about a mile, and is opened for nearly a half-mile by the new shafts. The Calico is a peculiar amygdaloid, ranging from almost a trap to nearly a conglomerate, carrying considerable felsite, with occasional patches of sandstone, and large quantities of epidote, prehnite and calcite. The strike is approximately N. 65° E., with a dip of about 46° 30′ and a width of 5′ to 25′, averaging about 9′ to 10′. Most of the copper occurs in 2′ or 3′ nearest the footwall. though occasional good patches occur in the center, or on the hanging. The metal carries a little silver in connection with it and is mostly in nodules, called shot-copper, with a little barrel-work and occasional small masses, the heavy copper occurring mainly near the intersections of numerous cross-fissures filled with clay gouge. The lode is strong and stands well without timber. The bed is sinuous, both as to strike and dip, and the walls are very irregular, the amygdaloid bed merging into the trap footwall by almost imperceptible degrees. There is also a tendency to split, the "footwall vein" being rich, where found, but leaving the main bed very lean in copper. There is also a "hanging-wall vein," and branch veins, in addition to which the Minnesota contact and North Minnesota fissure are found within 150′ distance of the Calico. The entire rock strata between the Calico and the Minnesota contacts, and for a little distance on either side, comes very near being a sort of magnified fahlband, where copper may and does occur at almost any point, even where least expected.

There are three new shafts on the Calico. "A" is the westernmost, located about 1,000′, on the strike of the lode, from the boundary line of the National mine. This shaft has 3 compartments, is 6x18′ inside of timbers and on Dec. 1, 1902, was 1,335′ deep, and sinking for the 12th level. The lode runs as wide as 18′ in this shaft, and shows some excellent stopes.

"B" shaft is 985′ east of "A" and was 1,535′ deep on Dec. 1, 1902. It has 2 compartments and is the main shaft of the mine. The Burnham sinking pump used here has 16x24″ steam cylinders, 10-gallon water-end, 16″ stroke, 6″ discharge and can fork 400 gallons per minute from a quarter-mile depth. "A" and "B" shafts are connected on the second and third levels. The Calico runs 20′ to 25′ wide in places in this shaft, and the lower levels show some good stopes. The most important developments, however, are in the "branch vein." This ore body is between the Calico and contact, underlying the former at a short distance on the 5th level, and receding therefrom steadily, so that at the tenth level it is near the Minnesota vein, and quite certain to join it. This branch vein is unknown at surface. At its point of junction with the Minnesota contact there should be more copper in sight than has been seen in Ontonagon county for nearly half a century. The branch vein is narrow, but very rich, and has been opened on the 5th, 6th, 8th, 9th, 10th, and 11th levels, by crosscuts. The showing is especially fine on the 5th, 6th, 9th, 10th and 11th levels. An immense mass has been cut in the 9th level, from which fourteen tons of copper were chiseled off to permit the drift to pass, the balance of the mass, of unknown extent, remaining in place for future extraction. The eleventh level is 100′ below the deepest workings of the old Minnesota, and the present owners will soon demonstrate that the Minnesota management was unwise, as well as cowardly, in quitting work when and where it did.

The old workings of the Minnesota were unwatered from "B" shaft by drill-holes bored across at each successive level, as depth was gained. The process was slow, but cheap and safe. The old workings have been found in bad shape, after three decades of neglect, and reopening and retimbering must be done slowly and safely.

"C" shaft is 1,353′ northeast of "B" and is 353′ deep, with a little drifting done on the first and two intermediate levels above. The formation is more settled than to the westward and the showing in copper better than was secured in the other levels at similar depth.

The permanent hoisting plant for "A" and "B" shafts is midway between. The completed building will be 50x115′, with hoists back to back, leaving a central space to be occupied by air compressors. The "A" section of this structure, now building, is 48x50′ and is to have a Webster, Camp & Lane hoist, good for 3,000′, early in 1903. Hoisting cables will pass around large and solidly anchored sheaves, giving a straight pull at each shaft. The old hoist at "A" shaft has a 4′ drum and 9x15″ cylinders, and there is a hoist with 6′ drum and 12x15″ cylinders at "B" shaft. There is a 10-drill Ingersoll Sergeant compressor at "A" and a 12-drill two-stage Norwalk and 5-drill auxiliary compressor at "B." Southeast of the new engine house is a 36x40′ boiler house, with 12′ coal-storage addition. The shafthouse was enlarged and the east compartment of "B" shaft put in commission in 1902.

Miscellaneous buildings include a substantial old stone smithy, with 3 forges; a model changing-house 22x50′, for 125 miners; well equipped carpenter and machine shops; warehouse; office; barns, and about 40 good dwellings. Water mains and hydrants afford fire protection. The pleasant village of Rockland is less than a mile distant, and the C., M. & St. P., Copper Range and Mineral Range railroads reach the vicinity of the mine.

A mill-test of 1,100 tons of Calico rock was made at the Atlantic mill in June, 1900, this being taken from all openings and from the burrows on surface, being chosen to secure an average of the rock opened and not to make a good showing from selected rock. Returns were a little more than 1% mineral, or about 0.75% copper, with 0.31% copper lost in the tailings. With the improved showing since secured in the Calico shafts, and by judicious selection, the Calico should give good returns in a mill.

The Michigan has reached a stage of development where the building of a mill is warranted, and several locations are under consideration. A site is owned at Ten Mile Point, on the shore of Lake Superior, in the Ontonagon district, but lacks a harbor and has shallow water. A site at Four Mile Rock, Lake Superior, owned by by the Adventure company, is also under consideration, as is a site at the mouth of the Graeverat river. The Michigan has been well handled, in every detail, and if it does not give a good account of itself, when production is begun, will greatly disappoint and surprise its many friends.

**MICHIGAN COPPER & GOLD MINING CO. UTAH.**

Office: Salt Lake City, Utah. Organized December, 1902, under laws of Utah, with capitalization $300,000, shares $1 par. Michael H. Osborne, president; Chas. C. Wirth, vice-president; Thos. G. Love, treasurer; L. C. Van Voorhis, secretary. Was organized to operate the New York group, in the San Francisco district of Beaver Co., Utah.

**MICHIGAN MINING CO. WYOMING.**

Address: care of D. W. Gill, Cheyenne, Wyo. No returns secured.

**MICHIGAN BOY MINING & MILLING CO. WYOMING.**

Office: Denver, Colo. Dr. C. W. Long, superintendent. Property supposed to be in Carbon Co., Wyo., but no returns secured.

**MICHIGAN & MONTANA COPPER MINING & SMELTING CO. MONTANA.**

Principal claims are the Cracker, Josephine and Bulls Head, near Altyn, Teton Co., Mont. Properties are said to show fair values in copper and gold, and to have a small stamp mill. Mines are located some distance from railroad transportation. Company supposed to be desirous of selling the property.

**MICHIGAN-NEW MEXICO COPPER CO. NEW MEXICO.**

Lands are in the Virginia district, near Lordsburg, Grant Co., N. M. Wm. H. Stevens, superintendent. Assays are said to show 8% copper, $8 silver and $12 gold per ton. Company was building a 30-ton concentrator at last accounts.

**MICHOACAN-SAN FRANCISCO COPPER MINES SYNDICATE, LTD. MEXICO.**

Office: 31-2, King William St., London, E. C., Eng. R. H. Pye, chairman; J. L. W. Mock, secretary. Capital, nominal, £55,000. Company is said to own copper properties in the state of Michoacan, Mexico. No returns secured.

**MID MOONTA MINE. AUSTRALIA.**

Address: care of John S. Scott, Grenfell St., Adelaide, South Australia. Owners of mine were arranging to resume operations, some time ago. No returns secured.

**MIDNIGHT MINE. ARIZONA.**

At Chloride, Mohave Co., Ariz. St. Charles Bros., owners. A vein carrying silver-copper ores is being developed by shaft.

**MIDDLEMARCH COPPER CO. ARIZONA.**

Office: 212 Henne Bldg., Los Angeles, Cal. Mine office: Middlemarch, Cochise Co., Ariz. Employs 24 men. Organized 1897, under laws of California, with capitalization $1,000,000, shares $100 par. H. Bert Ellis, president; M. M. O'Gorman, vice-president and general manager; Dr. Wm. LeMoyne Wills, secretary; Broadway Bank & Trust Co., Los Angeles, treasurer. Directors are H. Bert Ellis, M. M. O'Gorman, Richard Gird, Wm. K. Gird, Dr. Wm. LeMoyne Wills and Rufus M. Horton. Angel Moreno, mining captain. Lands, 23 unpatented claims, area 465 acres, in the Dragoon Mountains of Cochise Co., showing 6 fissure veins, of which 2 are being prospected, these having an average width of 40′, with estimated average value of 4% copper, 60 cents gold and 2 oz. silver per ton, from carbonate and sulphide ores. Has shafts of 90′ and 200′; tunnels of 110′ and 700′, with 3,000′ of underground openings. Ore blocked out for stoping is estimated at 100,000 tons. Has a complete steam plant, part of a concentrating plant and a 40-ton smelter, shipping product as 55% matte. Will continue underground development and complete concentrating plant in 1903.

**MIEDNOROUDIANSK MINE. RUSSIA.**

In the government of Nijni Tagilsk, Russia. Famous for producing a great variety of copper minerals, and especially noted for the production of massive malachite suitable for decorative and interior building purposes, one mass of malachite weighing 330 tons having been found in 1836. Property apparently idle, as the Russian government gives no returns of production in recent years.

**MILFORD COPPER MINING & SMELTING CO. UTAH.**

Address: care of F. H. Lathrap, Salt Lake City, Utah. Organized late in 1902, to develop copper properties in the vicinity of Milford, Beaver Co., Utah.

**C. S. MILLS & CO. MEXICO.**

Office and mines: Horcasitas, Sonora, Mexico. C. S. Mills, superintendent. Operate La Colorado group, carrying gold, silver and copper ores. Mines opened by shaft and tunnel and equipped with steam power. Five-stamp mill and concentrating machinery were being installed in fall of 1902.

**MILTON COPPER CO. MICHIGAN.**

Address: care of Henry M. Powers, receiver, Ontonagon, Mich. Has 380 acres, located a few miles from the Norwich, west of the Ontonagon river, Ontonagon Co., Mich. Affairs of company being wound up.

**MILWAUKEE-PALMER MOUNTAIN GOLD & COPPER MINING CO.**

Office: 23 Metropolitan Blk., Milwaukee, Wis. Location of property unknown and no returns secured.

**MINA GRANDE CONSOLIDATED MINING & MILLING CO.**

A New Jersey corporation that has paid up its entire capital of $5,000,000 by $4,999,000 worth of mining lands and $1,000 in cash. Address of company and location of lands not secured.

**MINDOULI MINE. FRENCH CONGO.**

Address: Comba, via Brazzaville, French Congo State, Africa. Property is supposed to have a limited development only, and so far as learned is not yet a producer.

**MINE DEVELOPMENT ASSOCIATION. NEW MEXICO.**

Property, somewhere in Socorro Co., New Mexico. C. T. Brown, manager. Was opening silver-copper ore bodies, by tunnel, with small force, at last accounts.

**MINERAL MINING CO.** **OREGON.**

Mine office: Huntington, Baker Co., Ore. H. C. Stratton and A. J. Crook, managers. Is opening copper ore bodies by tunnel. Has steam power and small smelter.

**MINERAL CREEK COPPER CO.** **ARIZONA.**

Owns the Hummer group, near head of Mineral Creek, somewhere in vicinity of Globe, Gila Co., Ariz. E. P. Nelson, of Minneapolis, Minn., is a director. Address of company and other particulars not secured.

**MINERAL HILL COPPER SYNDICATE.** **ARIZONA.**

Offices: 194, St. Vincent St., Glasgow, Scotland. Mine office: Prescott, Ariz. J. I. McConnell, chairman. Dr. Theodore B. Comstock, general manager; W. C. Bashford, local agent. Capital, nominal, £5,000. Lands, 2 claims near Huron, Yavapai Co., Ariz. Ores carry promising values in copper, gold and silver. Company has recently organized the Argyle Mining Company, Ltd., with a nominal capital of £100,000, to acquire the Yavapai county lands.

**MINERAL HILL MINING CO.** **WASHINGTON.**

Mine office: Conconully, Okanogan Co., Wash. Geo. H. Wheeler, manager. Is developing gold and copper ores by shafts and tunnel, with steam power equipment. Is said to be working about 40 men. No returns secured.

**MINERAL HILL MINING & SMELTING CO.** **CALIFORNIA.**

Mine office: Spenceville, Nevada Co., Cal. C. C. Bitner, superintendent. Lands, 5 claims, on which considerable development work has been done, showing promising values in gold and copper. Water power is used and a small force employed.

**MINERAL MOUNTAIN CLAIMS.** **CALIFORNIA.**

Consists of six unpatented claims, about three miles south of Iron Mountain, Shasta Co., Cal. Owned by D. T. Callahan and others, of Keswick, Cal. A sulphide ore body has been opened by a 200′ tunnel.

**MINERAL POINT MINING CO.** **COLORADO.**

Lands, in the Crystal district, near Gunnison, Colorado. Said to have a 360′ tunnel, all in ore, 5′ of which assays $19 per ton in copper, lead and silver. Mine is shipping a limited amount of ore.

**MINGUS MOUNTAIN COPPER CO., LTD.** **ARIZONA.**

Office: Grant Bldg., Los Angeles, Cal. Mine office: Jerome, Yavapai Co., Ariz. Organized under laws of Arizona, with capitalization $3,000,000, shares $1 par. R. A. Thomas, president; Thos. E. Metcalf, vice-president; W. W. Thomas, secretary; W. R. Shilling, superintendent; Albert Beven, mining captain. Lands, 38 unpatented claims, area 750 acres, in the Black Hills district of Yavapai Co., showing 3 fissure veins, of which 2, carrying oxide and sulphide ores, are developed by 3 shafts, deepest 370′. Has 3,000′ of underground openings, and steam plant. Company reports ore body as having extreme width of 40′ and length of 4,000′. Property well located and regarded as promising.

**MINNEAPOLIS COPPER MINING & MILLING CO. MONTANA & WYOMING.**

Office: Minneapolis, Minn. Mine office: Boulder, Jefferson Co., Mont. A. R. Olson, president; F. C. Carlson, secretary; J. J. Holmes, manager. Capitalization $500,000, shares $1 par. Lands, 4 claims in the Encampment district of Carbon Co., Wyoming, and sundry claims near Boulder, Jefferson Co., Montana. No returns secured.

**MINNEHAHA CLAIMS. WASHINGTON.**

Address: care of D. F. Strobeck, Spokane, Wash. Property located on east fork of Chewelah Creek, Washington. Has a short tunnel and ores give average assay value 6% copper, $7 gold and 6 oz. silver per ton.

**MINNESOTA MINE. MICHIGAN.**

Now owned by Michigan Copper Mining Co., which see, for description.

**MINNIE GULCH MINING & TUNNEL CO. COLORADO.**

Mine office: Silverton, San Juan Co., Colo. S. G. Martin, superintendent. Has ore bodies carrying gold, copper and silver. Mine is opened by tunnels and equipped with steam power. Said to be employ a considerable force, but no returns secured.

**MINNIE HEALY MINING CO. MONTANA.**

Office and mine: Butte, Silver Bow Co., Mont. Ninety-five per cent. of the stock issue is held by the United Copper Co. Title to mine is in dispute, and property is in the hands of E. H. Wilson, receiver. Two-compartment main shaft is about 1,000′ deep, and connected underground with the Leonard, Rarus and Tramway mines. Employs about 100 men when operated. Idle at last accounts, owing to litigation.

**MINNIE MABEL GOLD & COPPER MINING CO. WYOMING.**

Mine office: Rambler, Carbon Co., Wyo. H. G. Richardson, president and general manager. Lands, 9 claims, area 180 acres, near the Doane-Rambler mine, in the Battle Lake mining district of Carbon Co.

**MINONG MINE. MICHIGAN.**

The most important property ever developed on Isle Royale, Michigan. Has several shafts, deepest 300′. Opened 1874, closed 1879. Made 249 tons, 650 pounds refined copper.

**MINONG RANGE COPPER CO. WISCONSIN.**

Mine office: Gordon, Douglas Co., Wis. W. A. Dunn, superintendent. Lands, on sections 11, 12, 13 and 14 in Range 43 North, Town 10 West. Two shafts, 7x10′ are being sunk at an angle of 36°, in a dark amygdaloid. Considerable heavy copper has been secured from one shaft. This property differs from the other explorations in Wisconsin in that it is located on the southern fold of the Keweenawan synclinal, on which the developed mines of the Lake Superior native copper district are located. Merely a prospect at present, but one of the most promising ever secured in Wisconsin.

**MINOVACA MINE. WASHINGTON.**

At Bossburg, Stevens Co., Wash. Owned by Wells & Evans. Has gold and copper ore, opened by a shaft. No returns secured.

**MINT GROUP. WASHINGTON.**

Owned by D. F. Strobeck, Spokane, Wash. Claims are located on Gold

Hill, near Myers Falls, Wash, and show 3 veins, 8' to 25' wide, opened by a short tunnel and shaft. Assays give 8% copper, 5 oz. silver and $8 gold per ton.

**N. MIRANDA Y COMPANIA.** **CHILE.**

This firm was operating copper mines at Freirina, Atacama, Chile, at last accounts. No returns secured.

**MITCHELL DEVELOPMENT CO.** **ARIZONA.**

Office: Ishpeming, Mich. Samuel Mitchell, Negaunee, Mich., president and general manager; Jas. Chynoweth, vice-president; A. B. Miner, secretary and treasurer; Gus Baron, Bisbee, Ariz., superintendent. Lands, 33 claims, area about 800 acres, in the Montezuma Canyon of the Huachuca Mountains, Cochise Co., Ariz., including the New York, California & Arizona, McDowell, Baron, Gerdes, Beauchamp and other claims. Property gives a fine showing of rich surface ores, and includes one antigua, or old mine operated under Spanish domination. Company is composed of experienced mining men with strong financial backing, and property is to be developed vigorously.

**MITCHELL MINING CO.** **MEXICO.**

Office: 52 Wall St., New York. Branch offices: 522 Bradbury Bldg., Los Angeles, Cal.; 1302 F St., Washington, D. C., and Prescott, Ariz. Mine office: Acapulco, Guerrero, Mexico. Geo. Mitchell, president and treasurer; Thos. H. Anderson, vice-president; C. E. Crary, secretary, Los Angeles; H. S. Fairchild, assistant secretary, New York. Directors are Geo. Mitchell, Thos. H. Anderson, C. E. Crary, Myron M. Parker, Jacob Weidman, Geo. A. Fitch and Robt. E. Morrison. Walter R. Hersey, counsel; Danl. F. Sheehan, superintendent. Organized under laws of Arizona with capitalization $5,000,000, shares $10 par, non-assessable. This company owns the entire stock issue of La Dicha Mining & Smelting Co., the Mexican corporation that holds direct title to the company's mines. Lands of the company are approximately 750 acres, comprising La Dicha group of 20, McKinley group of 20, Edward VII group of 12, Hersey group of 96, and Odell group of 152 pertenencias, a total of 300 pertenencias, giving a solid parallelogram with the axis of the tract along the strike of the vein. These lands are in the districts of Bravos and Tavares, state of Guerrero, Mexico, about 25 miles in an air line from Acapulco, which is one of the best ports on the Pacific. The company also has about 250,000 acres of timber lands, covered with medium and high-grade woods, including some very fine yellow pine and some good oak. These lands will be given an abundant supply of timber for mining, building and commercial purposes for decades to come. A good trail has been built from La Dicha mines to the public road between Chilpancingo and Acapulco, and a trail will also be built from the railroad bridge over the Balsas river direct to the mine, cutting in half the distance for freighting by pack animals. The Mexico, Cuernavaca & Pacific railroad, recently acquired by the Mexican Central Railway, is in operation to the Balsas river, and is to be pushed to Acapulco, passing through the principal properties of the Mitchell Mining Co. and giving direct rail communication to all Mexican and American ports. The climate is good, with very little difference in temperature between the rainy and dry seasons. The country is healthy and the soil fertile.

On the mining property there is a large gossan outcrop for the full distance of 3 miles. Country rocks are granite, porphyry, limestone, schists and quartz, the ore body having a granite footwall and schistose hanging. The property has been thoroughly prospected and partly developed by nature, as a considerable stream of water has cut through the schist, exposing the ore body on the hanging wall, in addition to which no less than 4 smaller tributary streams have cut across the formation at approximately right angles, these streams having cut down their beds to depths of 150′ to 200′, exposing an ore body 175′ to 200′ wide. This ore body has been exposed to a depth of 745′ at one point, and by reason of the unparalled natural development, it is possible to estimate the extent of the deposit, which is placed by Mr. Mitchell at 30,000,000 tons of 6% self-fluxing sulphide ore.

La Dicha group is 600 to 800 meters wide and 7,700 meters long. The ascertained length of the ore body at the close of 1902 is given as 5,000′, but it is evident that further extensions are altogether likely to be found. The country rock adjoining the ore body shows but little oxidisable material. Work is now being pushed on the sinking of 3 shafts and the driving of 11 tunnels, 5 of which have just been started. These are almost entirely in a sulphide ore body, showing some tetrahedrite, but mainly composed of slightly auriferous chalcopyrite averaging about 6% copper. The tunnels tap the ore body at depths of 200′ to 500′ below the outcrop.

About 20 dwellings have been built for workmen, and smithy, assay office, etc., have been erected. Considerable machinery is in transit, this being brought in by pack animals. A large force of workmen is employed in preliminary operations, day and night shifts being worked. The supply of native labor is large, cheap and fairly good, daily wages ranging from 50 cents to $1.50 Mexican.

A smelter site has been selected at a 75′ waterfall, near the mines, and the company plans the erection of a 1,000-ton smelter in 1903. This will be so built that it can be increased in capacity later, as needed, at minimum cost. The ultimate plans of the company include an electrolytic refinery and a sheet and wire mill to turn out manufactured copper. The chemical composition of the ore is such that no fluxing will be required. Australian coke will be used for fuel, this costing $5 per ton in Acapulco and $11.50 per ton when delivered at the mine by wagons, and will cost $7.50 per ton when the railroad line is completed, giving a fuel cost less than that of the average smelter in Mexico or the western states of America. The water supply is ample, and available water power on the company's lands is estimated at 15,000 to 20,000 h. p., in the dryest season.

Mr. Mitchell is a practical mining man and metallurgist, of large experience in Wales and in such American mines as the Boston & Montana and United Verde, and the Greene Consolidated of Mexico. The property of the Mitchell Mining Co. is, beyond question, one of exceptional merit, and while several years of time and several millions of dollars in money will be required to put this property among the large producers, nothing but gross mismanagement can prevent its ultimately becoming a very large and successful mine. The present management seems a conservative one, and is composed of men of the best standing.

**MITSU BISHI GOSHI KWAISHA.** **JAPAN.**

Office: Mitsu Bishi Bldg., Yayescho, Tokyo, Japan. Mine office: Hanawa, Kazuno, Rikuchu, Japan. T. Nanbu, president; S. Harada, vice-president; S. Sho, secretary; R. Tayakawa, treasurer; A. Yamada, general manager; K. Ishihara, superintendent; K. Okamoto, smelter superintendent; K. Ikeda, mill superintendent; T. Kawamura, mining engineer; B. Yamazaki, purchasing agent; W. Matsuhashi, mining captain. Mining lands, about 1,000 acres, with 200 acres miscellaneous lands, in the Osaruzawa district of Kazuno, Rikuchu, showing innumerable fissure veins of an average width of 3′, with great length and average depth of 500′, giving average returns of 6% copper, from sulphide ores. Has 8 shafts, deepest 470′, with 7 main tunnels, longest 1½ miles, and about 15 miles of underground openings. Has a 250-h. p. electric plant and a smelter, latter turning out blister copper 99.09% fine. Estimated production for 1902 is 2,448,000 lbs. In 1903 company will install an electric hoisting plant, rock drills, Wilfley tables and Herreshoff roasting furnaces.

**MITTERBERG MINES.** **AUSTRIA.**

At Salzburg, Austria. At last accounts were working a vein of 6′ to 9′ carrying sulphide copper ores, gold, nickel and iron ore. Is a small producer. No returns secured.

**MOBILE MINE.** **GEORGIA.**

A property in Fannin Co., Ga., on which a small amount of work was done some years ago. Now idle.

**MOCTEZUMA COPPER CO.** **MEXICO.**

Office: 99 John St., New York. Mine office: Nocozari, Sonora, Mexico. Property is active, employing a large force. Organized under laws of West Virginia, with capitalization $3,000,000. James Douglas, president; Geo. Notman, secretary and treasurer; Jas. S. Douglas, superintendent. Lands are in the Moctezuma and Arispe districts of Sonora, Mexico, including the Pilares de Nacozari mine, opened by shafts and tunnels. Ore is highly silicious, and 90% of the values is saved in concentration. Has a two-section concentrator, with 4 Blake crushers, 4 sets of roughing rolls, 1 set of finishing rolls, 24 revolving screens, 48 Hartz jigs, 4 sets of 54x3″ rolls, 10 Huntington mills, 56 six-foot vanners and 20 Bartlett tables. About 40% of the concentrates go direct to the smelter, and 60% are briquetted, 5% of clay being used for a binder. Smelter has two elliptical water-jacket furnaces, of the Copper Queen type, 42x130″, and two stands of converters, a lean gold-silver-bearing quartz being used for lining. Company also has a fuel gas plant, making producer and water gases, which are stored in separate gasometers and mixed in due proportion before use. Smelter is 5 miles from mine, connected by a narrow gauge railroad running to the Arizona line. The company maintains English and Spanish schools for the children of the employes. Product is turned out as blister copper averaging 99% fine. Production for 1902 is estimated by company at 9,800,000 pounds.

**EL COBRE DE MOCTEZUMA. MEXICO.**

Property by this name said to be operating near Moctezuma, Sonora, Mexico. No returns secured.

**MODEL GOLD MINING CO. ARIZONA.**

At McCabe, Yavapai Co., Ariz. Property carries gold, silver and copper, and is equipped with steam plant and 10 stamps. Company paid dividends and sold stock simultaneously, and came to grief.

**MODERN COPPER MINING CO. ARIZONA.**

Office and mine: Bisbee, Cochise Co., Ariz. Employs 21 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par, non-assessable. N. A. Centers, president; O. H. Briggs, vice-president and general manager; R. A. Miller, secretary; J. T. Hood, treasurer. Directors are preceding officers, H. V. Harsha, W. A. Bateman and John R. Ryan. Jos. Miller, superintendent. Lands, 28 unpatented claims, area 560 acres, in the Warren district of Cochise Co., showing five fissure veins carrying carbonate and sulphide ores, of which one is being developed, this giving an average assay of 7% copper, 10% lead, 1 oz. gold and 14 oz. silver per ton. Has four shafts, of 40′, 50′, 100′ and 225′. Has steam power equipment. Nearest railroad, 6 miles. During 1903 company will sink to 1,000′ level, also drift and crosscut and add power drills and compressor, and may decide to install a 200-ton smelter.

**MODOC MINE. NEW MEXICO.**

Located in Grant Co., N. M. Did considerable development work in 1901. No returns secured.

**MOGOLLON GOLD & COPPER CO. NEW MEXICO.**

Office: Albuquerque, N. M. Branch offices: 835 Spitzer Bldg., Toledo, Ohio, and Cooney, N. M. Thos. J. Curran, president; Wm. Jenks, vice-president and consulting engineer; Geo. L. Brooks, secretary; Wm. J. Weatherby, superintendent. Mines are in the Mogollon Mountains, Socorro Co., N. M. Company plans building a 100-ton smelter.

**MOHAWK MINING CO. MICHIGAN.**

Office: 11-13 William St., New York. Mine office: Kearsarge, Mich. Mill office, Gay, Mich. Is employing several hundred men and will be a heavy producer during 1903. Organized, November, 1898, under Michigan laws, with capitalization $2,500,000, shares $25 par, $19 paid in. Annual meeting, last Tuesday in March. Boston Safe Deposit & Trust Co., registrar; American Loan & Trust Co., of Boston, transfer agent.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $1,288,410.32 |
| Amount paid in by conveyance of property to company | 450,000.00 |
| Entire amount invested in real estate | 456,236.17 |
| Amount of personal estate | 79,628.63 |
| Amount of unsecured or floating debt | 48,293.96 |

| | |
|---|---|
| Production of copper, 1901, in pounds | 160,897 |
| Production of mohawkite, 1901, in pounds | 380,800 |

Items of income and expenditure for 1901 were as follows:

| | |
|---|---|
| Receipts: | |
| Balance from 1900 | $136,181.53 |
| From assessments | 297,299.50 |
| From 170 long tons mohawkite | 15,789.14 |
| Interest | 2,075.14 |
| Total receipts | $451,345.31 |
| Expenditures: | |
| Underground openings | 128,533.99 |
| Surface expenses at mine | 28,527.99 |
| Construction account | 256,249.62 |
| Total Expenditures | $413,311.60 |

An assessment of $3 per share was levied April, 1902. On account of the great delay in completing the new mill an additional assessment of $2 will be called in January, 1903.

John Stanton, president; John R. Stanton, secretary and treasurer; John Stanton, Jos. E. Gay, John R. Stanton, Wm. A. Paine, and Fred Smith, directors. Fred Smith, superintendent; Willard J. Smith, assistant superintendent; Frank Getchell, clerk; B. S. Shearer, mill superintendent; John Trevorrow, mining captain; F. Wm. Hartmann, mining engineer.

Mineral lands are 800 acres, in an irregular tract having its axis on the strike of the lode, in Sections 27, 28, 33 and 34, Town 57 North, Range 32 West, Keweenaw county, Michigan. The Kearsarge amygdaloid lode, on which the mine is opened, extends for about one mile on the Mohawk lands and despite the common notion that the mine will be but a shallow one before reaching its western boundary, the deepest shaft can be sunk on the dip of the lode for nearly one and a half miles on the company's present lands. The Mohawk is 4 miles northeast of Calumet, and has the Ahmeek and Seneca on the north, the Bacon & Jacob tract on the east and south, and the Ahmeek on the west. The southern boundary is a trifle more than one-half mile from the northern boundary of the Kearsarge mine of the Osceola Consolidated, and the southernmost shaft is about two miles northeast of the northernmost shaft of the Wolverine, opened on the same lode.

The Mohawk is one of the few really new mines of the Lake Superior district, many of the other new corporations having merely resumed work at old properties. The Mohawk was formerly known as the Fulton, and was generally supposed to lie too far east to carry the outcrop of the Kearsarge lode. The Ahmeek property, lying next west of the Mohawk was explored for the Kearsarge outcrop, without success. It is apparent that there is a much greater deflection of the formation to the eastward, in making north, than was formerly supposed. The Kearsarge bed was discovered accidentally on the Mohawk property by the cutting of a wood-road, about 1896. Explorations were conducted quietly by Mr. Jos. E. Gay, and when it became apparent that the find was of importance, the Mohawk company was organized. The shares were placed on the market at $7.50 each, and many subscribers were unable to obtain stock. The first sales, after the organization of the company, on the curb, were at $15, and the Mohawk is one of two or three out of the thirty new mining companies of the Lake Superior district that has not seen its shares drop below subscription price, during some of the various severe breaks in the market following the great copper boom of 1898–1899.

While the Mohawk property carries other cupriferous lodes, no attempt has been made to locate or explore them, work having been confined to the development of a mine on the Kearsage amygdaloid. When the mine is paying dividends it will be time to consider the matter of explorations on the extensive tract owned by the company. Work has been done on fissure veins, but as these were cut in opening the amygdaloid, such operations cannot be considered as exploratory work.

The Mowhak has four shafts, numbered from north to south. No. 1 is located about 1,500′ south of the point where the outcrop of the lode passes over the northern line. This is to the 7th level, about 800′ deep. No. 2 is about 1,100′ southwest of No. 1, and is to the 7th level, about 700′. No. 3 is 1,100 ′ next southwest and is to the 6th level, about 650′. No. 4 is 1,300′ next south, and to the 5th level, nearly 500′. Shafts are uniform, with 3 compartments, 8x18′ inside measurement. Surface equipments of the shafts are to be similar throughout. The first three shafts are fitted with permanent surface plants, including combination shaft-rockhouses, with 12x24″ Nordberg engines, crushers, and hoists good for 1,500′. No. 4 will have a permanent hoist and balance of equipment in 1903. Shafts 1, 2 and 3 are connected by drifts on the first to sixth levels inclusive, except on the third level between shafts 2 and 3.

At the close of 1902 the mine has about 5 miles of underground openings, showing much above the average of Lake amygdaloids in copper. The lode runs 15′ to 18′ wide, or about the same as the Wolverine, but is apparently a little less bunchy and a trifle richer in copper. The openings from No. 1 are good; the north drifts of No. 2 are uniformly good. Between shafts 2 and 3 there is some poor ground, though affording some good stopes. No. 4 was the poorest shaft of the mine at surface, but is now possibly the best at depth, the south drifts being remarkably good.

There are three fissure veins with nearly vertical dip crossing the amygdaloid at approximately right angles, which carry sundry arsenides of copper, including stibio-domeykite, mohawk-whitneyite, mohawkite and keweenawite, for descriptions of which see chapter on mineralogy. The most important of these ores is mohawkite, which is an arsenide of copper, nickel and cobalt in varying quantities, with an average of about 62% copper, 7% nickel and 20 oz. silver per ton. The first and principal fissure was cut in the north drifts of No. 1 shaft, and varies greatly from point to point, having been rich near surface, poor in the 5th level and improving below. The fissure runs from 3″ to 3′ in width and is mineralized at the crossing of the cupriferous amygdaloid, and for an indefinite but usually short distance on either side, averaging 20′ to 30′. The fissure is apparently strong and liable to hold to 2,000′ or more in depth. The second fissure carrying arsenical ores was cut in No. 2 shaft, and so far has proven of small value. A third fissure near No. 3 shaft is likewise of little importance so far, and of small promise. The mohawkite and allied arsenides of copper are disseminated in an arenaceous gangue, occasionally occurring massive, and varying greatly in percentage and consequently in value, from point to point, The ore is hand-cobbed and barreled for shipment to a smelter especially built for its treatment, at Hackensack Meadows, N. J., the ore weighing 1,300 to 2,400 lbs. per barrel. A trial shipment of 70 tons sent to Swansea gave net returns of $140 per ton, but the average returns will probably be about half this amount. The mohawkite and allied arsenical ores from the fissure viens afford a by-product of importance, and one that will give almost net returns, but the big production of copper and the bulk of the profits must come from the Kearsarge amygdaloid.

The Mohawk is well supplied with buildings and machinery. The mine location contains a considerable number of substantial and thoroughly comfortable dwellings. There are the usual shops, among these being the machine shop, smithy and combination carpenter shop and warehouse, each 30x60′ in size. There are also boiler and engine houses at each shaft, barns and a variety of miscellaneous buildings.

The Mohawk is reached from the south by the Mineral Range Railroad. The Mohawk and Wolverine are joint owners of the Mohawk & Traverse Bay R. R., with 13 miles of main line. This was originally a narrow-gauge logging road, but was widened to standard gauge in 1902. The Mineral Range R. R. operates this line, under agreement with the owners, which is probably a profitable arrangement for all concerned.

The Mohawk and Wolverine mills are twins, standing near the mouth of the Tobacco river, on Traverse Bay, Lake Superior. A 20,000,000-gallon triple-expansion Snow pump furnishes water for both mills. The pumphouse is on the river, from which water is taken, thus obviating the necessity for driving a long and expensive tunnel under the bed of Lake Superior, as in the case of many new mills in the district. The mill is 178x206′, of steel frame with iron sheathing, on foundations of sandstone taken from the company's own quarry. A steel trestle 350′ long and 50′ in extreme height connects railroad and mill, loaded cars being pulled up this incline by a winding engine, instead of running the entire train into the top of the mill. The mill has room for four heads, and now contains two Nordberg stamps, the first of which went into commission in December, 1902, while the second should start early in 1903. The third and fourth heads will be added a little later, as they can be paid for out of earnings. The steel boiler house adjoins the mill and has four 250-h. p. Stirling boilers.

A townsite named Gay, in deserved honor of Jos. E. Gay, long and honorably identified with Lake Superior copper mining, has been laid out at the Mohawk and Wolverine mills. This has streets, water mains and hydrants, and a number of good dwellings. The wharf, a little distance from the mill, is 30x300′, with 14′ of water alongside and has coal-hoists and sheds ample for the needs of both mines.

The Mohawk is just starting production as this is written. The Mohawk company has the inestimable advantage of an experienced, aggressive and honest management. The mine has cost far more to open and equip than was expected when work was begun. It should make nearly or quite 9,000,000 lbs. of copper in 1903, and at a cost of not more than 8 cents and perhaps no more than 7 cents per pound. The mine has been condemned by people never within sight of any hole deeper or bigger than a fifty-foot driven well, but if the Mohawk does not prove itself a big mine and a profitable one, the author of this book will freely confess that he does not know the difference between a copper mine and a hole in a gravel bank.

**MOJAVE COPPER CO.** **CALIFORNIA.**

Is developing copper claims in the mountains between Red Rock and Gold Cañon, in the Mojave desert. R. D. Finnie, manager. Assays return 13% to 33% copper; company has the building of a small smelter under consideration.

**MOLLIE GIBSON GROUP.** **BRITISH COLUMBIA.**

At Menzies Bay, Discovery Passage, Nanaimo district, B. C. Some development work was done in 1901, and a promising copper ore body encountered. No returns secured, and property supposed to be idle.

**MOLLIE STARK COPPER MINING CO.** **WYOMING.**

Supposed to have copper claims in the vicinity of Elwood, Wyo. No returns secured.

**MONA & PARYS MINES, LTD.** **WALES.**

Offices: Amlwch, Anglesey, Wales. H. V. Harrod, secretary. Mining lands, 1,067 acres, with improved water frontage, warehouses, tramways, etc. Makes a small annual production of cement copper by precipitation from mine waters. Mines were worked in this distirict by the Romans. The Parys was opened in 1768 and made 3,000 tons of copper in 1784. Present production is 25 to 50 tons yearly.

**MONARCH COPPER MINING CO.** **CALIFORNIA.**

Mine office: Callahans, Siskiyou Co., Cal. Organized under laws of South Dakota. Has two veins, carrying cuprite, melaconite, malachite, azurite, bornite, chalcocite and chalcopyrite. Property is now being developed. No returns secured.

**MONARCH GOLD & COPPER MINES, LTD.**

Office: 543 Chamber of Commerce, Portland, Ore. Mr. B. Fallows writes that the property is only a prospect, and not worthy of a place in a list of copper mines.

**MONARCH GOLD & COPPER MINING CO.** **ARIZONA.**

Office: 219–53 State St., Boston, Mass. John B. Hadaway, president; Geo. E. Warren, secretary; G. P. Morrill, treasurer; C. L. Barker, general manager. Lands, in the Big Bug district of Yavapai Co., Arizona. Treasurer of the company writes that the property is not a producer and that mineral values are mainly gold.

**MOND NICKEL CO., LTD. ONTARIO.**

Offices: 36, Victoria St., S. W., Eng. Mine office: Victoria Mines, Ontario. Organized 1900, with capitalization £600,000, in 300,000 ordinary shares, par £1; 50,000 preferred shares, par £5, and 50,000 deferred shares, par £1. Dr. Ludwig Mond, chairman; Robert Mathias, secretary; Ludwig Mond, Sir Andrew Noble, F. R. S., Hon. G. A. Drummond, Chas. J. Galloway, J. P., Jas. Ross, Saxton W. A. Noble, Alfred Mond, Dr. Carl Lauger, Robert L. Mond, directors; Dr. Bernard Mohr, general manager; Hiram Hixon, manager at mines. Properties carry copper and nickel, and are equipped with steam power and aerial tramway. Has a smelter, completed May, 1901, and made 1,147 short tons of nickel-copper matte in 1901, matte being of high grade, averaging about 40% each in copper and nickel. The company also refines nickel and manufactures bluestone.

**MONITOR MINE. MONTANA.**

At Butte, Silver Bow Co., Mont. Owned by the Anaconda Copper Company and leased to Michael Farrel. G. A. Harrington, superintendent. Employs about 25 men; produces copper and silver. Is connected underground with the J. I. C. and Ground Squirrel mines.

**MONITOR COPPER MINING CO. BRITISH COLUMBIA.**

At Alberni, Vancouver district, B. C. Company was organized in 1901. E. A. LeWald, superintendent. Property is located on tidewater. Ore, mainly chalcopyrite in iron pyrites, mixed with magnetite; 992 tons of ore sent to Tacoma smelter in 7 lots returned $30 per ton. Mine has half-mile aerial tramway.

**MONTAGNAT MINE. NEW CALEDONIA.**

Mine office: Diahot, New Caledonia. This is a new property, in process of development, and apparently has a large ore body.

**MONTANA CONSOLIDATED MINING CO.**

Address: care of M. P. Hillyer & Co., 52 Broadway, New York. Company advertised to have something better than the Calumet & Hecla, but omitted giving town, county or state in which mines are located, and furnished no detailed reports in response to repeated inquiries.

**MONTANA COPPER & GOLD MINING CO. MONTANA.**

Office: 135 Adams St., Chicago, Ills. Mine office: Dillon, Beaverhead Co., Mont. Capitalization, $1,000,000. Albert G. Beaunisne, president; A. Percy Ballou, secretary; A. Mauser, superintendent. Lands, sundry mining claims in the Stone Creek district of Madison Co., Mont. According to statement filed with the secretary of state in Montana, company has no indebtedness. Was developing by crosscuts. Property closed down August, 1902, but company expected to resume work soon, at last accounts.

**MONTANA COPPER MINING CO. MONTANA.**

Former office: 111 Granite Blk., Helena, Montana; letter to this address returned unclaimed, October, 1902. Mine office: Helmville, Lewis & Clarke Co., Mont. Organized 1900, with capitalization $1,000,000, shares $1 par.

A. E. Spriggs, president; J. K. Waite, secretary. Lands, 120 acres, in the Big Blackfoot district of Lewis & Clarke Co. Property is developed by shallow shafts and long tunnels, showing a considerable body of medium-grade concentrating ore.

**MONTANA GOLD MINING CO.** **MONTANA.**

Supposed to be a consolidation of the International Copper & Gold Mining Co. of Mexico and the Montana Copper & Gold Mining Co., latter owning 7 claims, including the Ballarat, in Madison Co., Montana. No returns secured.

**MONTANA MINERAL LAND DEVELOPMENT CO.** **MONTANA.**

Mine office: Basin, Jefferson Co., Mont. P. A. Pauly, superintendent. Said to be opening gold, silver, and copper ores, by shafts, and to have a steam plant and 50-ton concentrator. No returns secured.

**MONTANA ORE PURCHASING CO.** **MONTANA.**

Office: 31 Nassau St., New York. Mine office: Butte, Silver Bow Co., Mont. Organized 1893, under laws of Montana, with capitalization $2,500,000. F. August Heinze, president and general manager; John MacGinnis, vice-president; Arthur P. Heinze, secretary; Stanley Gifford, treasurer. This corporation is controlled by the United Copper Co., which holds 76,791 shares of the capital stock issue of 80,000 shares, and the entire issue of $1,000,000 first mortgage bonds of the Montana Ore Purchasing Co. is also owned by the United Copper Co.

**MONTANA & ARIZONA COPPER CO.**

Charter surrendered and company out of business.

**MONTANA VERDE COPPER CO.** **MONTANA.**

Office: 21 Park Row, New York. Mine office: 82 Owsley Blk., Butte, Silver Bow Co., Mont. Jos. Johnston, general manager; N. F. Normandy, secretary and treasurer. Lands, 16 claims, in the Bernice district of Jefferson county. Organized 1902, under laws of South Dakota, with capitalization $2,500,000, shares $1 par. Mine shows assay values of 6% copper and $36 gold per ton. Has tunnels of 275′ and 350′. Was installing stamp mill and concentrator, near Bernice, in July, 1902.

**SOCIETE ANONIMA DELLE MINIERE DI MONTECATINI.** **ITALY.**

Offices: 49, Piazza Santa Apostoli, Rome, Italy. Mine office: Boccheggiano, Grosseto, Italy. Property is active, employing 700 men. Estimated output for 1902 and 1903 is 1,400 metric tons for each year. Organized 1888, with capitalization 5,000,000 lire, in 50,000 shares, par 100 lire. Dividends paid 1899–1902 have amounted to 77 lire per share. I. Castelbolognesi, president; Alfred Deschars, of Paris, vice-president; Alfredo Santori, secretary; Paul Marengo, general manager; Guglielmo Vallada, mining engineer.

This is a very ancient mine and has been worked successively by the Etruscans, Romans, Goths and Italians. The ores are chalcopyrite, bornite and chalcocite, and the mine is opened by one shaft of 125 metres and 5 tunnels, having about 7,500 metres of underground openings and 500,000 tons of ore in sight. Property is equipped with steam power throughout, and has a concentrating mill with 5 crushers, etc. The lower-grade ores are heap-roasted, leached, and the leach water run through tanks containing pig iron, giving cement copper. There is also a sulphuric acid plant for the utilization of the sulphur, which runs about 40% in ores averaging 3½% copper. Annual production is 5,000 to 6,000 tons of 9% to 10% copper ore; 12,000 tons of cuprous pyrites carrying 3½% copper and 21,000 tons of cuprous pyrites carrying 2½% copper. Nearest railroad station is Massa Maritima, 20 miles distant, on the Mediterranean Railroad.

**MONTE CRISTO MINE.** **MONTANA.**

Said to be located near Rimini, Lewis & Clarke Co., Mont., but letter to that address returned unclaimed, November, 1902.

**MONTEREY GOLD MINING CO.** **WASHINGTON.**

Mine office: Bolster, Okanogan Co., Wash. M. M. Walsh, superintendent. Is opening copper and gold ore body by shafts and tunnel, with a small force.

**MONTE RUBIO GROUP.**

Mine office: Paimogo, Huelva, Spain. Owned by C. & J. Sundheim. Wm. Guthrie Bowie, manager. Is a group of 3 government concessions, area 100 hectares, including the Monte Rubio, Gibraltar and Atbalcal Arbalcal mines. There are extensive remains of Roman and modern workings to the water level, showing numerous masses of ferruginous gangue, impregnated with copper occurring as oxides, carbonates, sulphides and sulphates. Property was leased to the United Alkali Co., of England, in October, 1902. Lessees, in case the mines develop according to their present promise, will build a railway 22 kilometres to Coiña Veral, for shipping purposes.

**MONTEZUMA MINING CO.** **WASHINGTON.**

A group of 6 claims located 9 miles from Fairfax, Wash. Ore occurs as slightly auriferous chalcopyrite in a fissure vein traversing diorite. Has only limited development.

**MONTGOMERY GOLD LEAF MINING CO.** **NEW JERSEY.**

Office: Belvidere, N. J. H. G. Deshler, secretary and treasurer. Acquired mineral rights in 1901 to 1,028 acres in Pahaquarry Twp., Warren Co., N. J. Property shows low-grade ore in old copper workings. Tunnel was being driven at last accounts.

**MONTPELIER MINING & MILLING CO.** **IDAHO.**

Mine office: Montpelier, Bear Lake Co., Idaho. Frederick Rose, manager. Was developing gold, silver and copper ores by shaft, with steam power, at last accounts.

**MONTREAL & BOSTON COPPER CO., LTD.** **BRITISH COLUMBIA.**

Office: Canada Life Bldg., Montreal, P. Q., Canada. Mine office: Greenwood, B. C. Employs 70 men. Organized 1898, under laws of Nova Scotia, with capitalization $3,000,000, shares $5 par, non-assessable. Annual meeting in April. Stock is listed on the Boston exchange. State Street Trust Co. of Boston, and Munroe & Munroe, 25 Broad St., New York, transfer agents; Old Colony Trust Co., of Boston, and Knickerbocker Trust Co., of New York, registrars. Cash surplus of company was $79,835 on Nov. 1, 1901. H. H. Melville, president; J. N. Greenshields, first vice-president; Thos. Crockett, second vice-president; A. Munroe, secretary and treasurer. Directors are preceding officers, J. C. McDiarmid, DeLancey Nicoll, Wm. Mitchell, G. Creighton Webb, W. F. Beal, J. Wesley Allison, Chas. M. Jesup and W. N. Coler, Jr. Harry Johns, mine superintendent; Albert I. Goodall, smelter superintendent; Malcolm Galbraith, mining engineer.

Lands, 4 claims, area 112 acres, held under crown grant, also smelter site of 32 acres and townsite of 80 acres, in the Deadwood camp of the Boundary Creek district, British Columbia. Lands show four lenticular ore bodies carrying low-grade sulphide ores containing large percentages of iron, silica and lime, the composition rendering the ores absolutely self-fluxing. The claims of the company are the Sunset and Crown Silver, on which the principal development has been secured, also the Jewel, Morrison No. 7, Ruby, King Solomon, C. O. D. and Florence fraction. The ores carry a little gold, but it has been impossible to learn the average percentage of copper, from the company or others. It seems probable, however, that the ore carries an average of 2% to 2.5% copper, with gold values of probably about $2 per ton. These figures however are merely estimates. The ore is so low in grade that it would not be worked under ordinary circumstances, but the conditions surrounding this property are altogether extraordinary. The ore is in very large bodies and mined at exceptionally low cost. The self-fluxing nature of the ore and other advantages enable the company to smelt at a fraction of the usual cost.

The main shaft at the Sunset mine is 412′ deep and the Crown Silver shaft is 265′. There is an 880′ tunnel, 502′ of raises, 64′ of winzes, 311′ of drifts, and 3,800′ of crosscuts, giving a total of 6,234′ of underground openings, with 250,000 tons of ore blocked out for stoping, and about 1,500,000 tons of ore in sight. An important strike on the 150′ level of the Crown Silver mine, in December, 1902, gave assay values of about $11 per ton, or practically double the previous average value. A trestle leads from the Sunset shaft to a 2,000 ton ore-bin on the railroad track, whence ore is loaded into cars for shipment to the smelter. The mine has a good power equipment including a No. 6 Cameron sinking pump, 80-h. p. double cylinder Lidgerwood hoist, with 14x20″ cylinders, 100-h. p. double cylinder Jenckes drum hoist, one-half of a 20-drill duplex Ingersoll-Sergeant air compressor, a 10-drill air compressor, two 80-h. p. boilers, power drills, machine shops, smithy, assay office, bunk houses and boarding house.

The smelter is at Boundary Falls, 4 miles from the mine, and is served by the Canadian Pacific Ry. The Great Northern railroad is building to the district. The smelter is 120x182′, and 78′ in height. It was built 1900–1901, with a single furnace, by the Standard Pyritic Smelting Co., but was never used until bought by the Montreal & Boston and blown in June 19, 1901. The furnaces are 40x176″ at the tuyeres, nominally of 300 tons and actually of about 400 tons daily capacity. The second furnace was blown in Dec. 1, 1902, and the third is being set and will be blown in about March, 1903. The smelter has crushers, rolls, Vezin and Bridgman automatic samplers, belt conveyers, No. 7 Connersville blowers, steam hoist, 250-light dynamo, etc. The dust flue, of stone and brick, is 200′ long, and the stack is 9′ 6″ in diameter and 112′ in height. Smelter has 16 ore bins, each 10x34′ in size, in the building, also

3 large ore bins and coke bins outside, railroad tracks running above all bins.

Fuel is cheap and ordinarily abundant, but a five-months' strike in the Canadian coal districts in 1902 caused a serious fuel shortage and greatly reduced the production of the smelter. There is plenty of water in the district and the company owns a good water power in Boundary Falls, adjoining the smelter. For 1903 the company plans installing 5 new furnaces and a converter plant, the product of the smelter now being turned out as matte, averaging 45% to 50% fine copper. Production for 1902 was 1,800,000 lbs. and 1903 output is estimated by company at 13,000,000 lbs. The mining and smelting costs are probably as low as can be found anywhere, and the company has a good management. It seems altogether likely that the Montreal & Boston will speedily take a leading place among the Canadian copper mines, and a position of no mean importance in the list of the world's large producers.

**MONTT HERMANOS. CHILE.**

Mines are near San Juan, Freirina, Chile. Principal properties are the Quebradita, 300′ deep, opened in 1834; Rosario, 280′ deep, opened in 1845; Manto, 160′ deep, opened in 1846, and San Jose, 180′ deep, opened in 1851.

**MONUMENT COPPER MINING CO. MONTANA.**

Incorporated August, 1902, by Joseph C. Heppler, Alex S. Christie and E. R. Heppler, of Butte, Montana. No returns secured.

**MOON GOLD MINING CO. CALIFORNIA.**

Office: Valley Springs, Cal. Mine office: Richey, Amador Co., Cal. J. B. Lucas, vice-president and general manager. Has two shafts, of 100′ and 140′. Vein-stuff is a sulphide mineralization of diabase and talcose shist. Property is being developed with a small force.

**MOON-ANCHOR COPPER MINING CO. WYOMING.**

Office and mine: Encampment, Carbon Co., Wyo. Employs 10 men. Organized 1901, under laws of Wyoming, with capitalization $1,000,000, shares $1 par, non-assessable. L. W. Tennant, president and general manager; Geo. Kuntzman, vice-president; W. J. Wernli, secretary and treasurer. Directors are preceding officers, Richard Herring and W. J. R. Herring. Lands, 3 unpatented claims, area 60 acres, in the Upper Platte district of Carbon Co., Wyo. A 50′ fissure vein of sulphide ore, assaying 10% copper, is being opened by a 200′ shaft, with drift at bottom. Mine has steam hoist and drills. Ore is taken 9 miles to smelter at Encampment. Company will sink its shaft 200′ and drift during 1903, also add an air compressor.

**MOONTA CENTRAL COPPER CO., LTD. AUSTRALIA.**

Offices: 30, Moorgate St., London, E. C., Eng. G. F. Bean, chairman; J. A. Russell, secretary; John S. Scott, manager, Adelaide, South Australia. Capital, £110,000. Property, 152 acres on Yorke Peninsula, South Australia, held on 99-year lease from June 30, 1892. Was sinking and opening at last accounts.

**SOCIEDAD MINERA DEL MORADO. CHILE.**

Owns the Arenillas mine, opened 1860, in the department of Freirina, Chile. Product is shipped as matte, when working. Mine idle at present.

**FRANCISCO MORAN.** **MEXICO.**

Address is given by Mexican government as a producer of copper at Mineral de Asientos, Aguascalientes, Mexico. No returns secured.

**MORENCI COPPER CO.** **ARIZONA.**

Office: 44 Broadway, New York. Mine office: Morenci, Graham Co., Ariz. Was formerly known as the Arizona Gold Mining & Milling Co.; later as the Gold Cliff Mining & Milling Co.; latterly as the Morenci Copper Co., and has been hard up under all names. Lands, sundry claims in the Morenci-Clifton district of Graham Co. Has a 150′ shaft, showing 6% copper ore on the Micawber claim. No returns secured in response to repeated requests.

**MORNING STAR MINE.** **CALIFORNIA.**

An old property in the Mogul district, north of Markleeville, Alpine Co., Cal., carrying gold, silver and copper ores, that run as high as 17% copper, $32 gold and 49 oz. silver per ton. Property is supposed to be idle.

**MORNING STAR MINING CO.** **ARIZONA.**

Mine office: Dewey, Yavapai Co., Ariz. E. Devlin, superintendent. Is supposed to be developing a copper ore body. No returns secured.

**MORROCOCHA MINES.** **PERU.**

Consul-general St. John writes me from Lima that it is reported there that an American syndicate has recently bought the Morrococha mines, in the Yauli district, paying £150,000 therefor. These mines are said, in Peru, to be as valuable as those of the Cerro de Pasco, but this estimate must depend on possibilities, rather than on results secured from past operations.

**MORONG MINE.** **VIRGINIA.**

A property near Virgilina, Va., said by the commissioner of agriculture of Virginia to have good prospects. No returns secured.

**MORRISON MINES, LTD.** **BRITISH COLUMBIA.**

Mine office: Deadwood, Yale & Cariboo district, B. C. F. H. Oliver, manager. Has gold-copper ores, opened by tunnel. At last accounts company was negotiating for sale of mines for a sum stated to be $185,000.

**MOTHER LODE COPPER MINING CO.** **VIRGINIA.**

Organized September, 1902, under laws of New York, with capitalization $1,500,000. No returns secured, but Joseph H. Morong, of Virgilina, Virginia, is one of incorporators and this company presumably takes over the Morong mine.

**MOUNT BABINDA MINE.** **AUSTRALIA.**

A property in Queensland. Ore is dressed by hand-cobbing to about 23% copper and 20 oz. silver per ton, with a small amount of gold. Production is on a very limited scale.

**MOUNT BULGA COPPER CO.** **AUSTRALIA.**

In the Orange division of New South Wales. Was developing at last accounts. Installed new machinery plant, 1901-1902, and had considerable underground openings, but had not begun stoping at last accounts.

**MOUNT CHALMERS COPPER MINES, LTD.** **AUSTRALIA.**

Company went into voluntary liquidation May, 1901; J. N. Tickner, 70, Bishopsgate, London, E. C., Eng., liquidator. Property is at Rockhampton, Queensland.

**SOCIETE DES MINES DE CUIVRE DE MONT CHALMERS.** **AUSTRALIA.**

Offices: Blvd. Haussmann, 50, Paris, France. Property presumably located in Queensland, Australia, and very likely the same company as the Mt. Chalmers Copper Mines, Ltd.

**MOUNT DIAMOND COPPER CORPORATION, LTD.** **AUSTRALIA.**

Offices: 18, Broad St. Ave., London, E. C., Eng. E. Fewings, chairman; L. G. Brown, secretary. Property, 240 acres of leasehold, 5 miles northeast of Wandie goldfields, South Australia. No returns secured.

**MOUNT DONALDSON COPPER CO., LTD.** **TASMANIA.**

Offices 63, Gracechurch St., London, E. C., Eng. H. Byrne, chairman; D. B. Cotton, secretary; capital, nominal, £150,000. Property is 150 acres, on Mt. Donaldson, Corinna, Tasmania. Latest accounts from Tasmania do not indicate that any attempts are being made at mining on this property.

**MOUNT EDDY MINING & DEVELOPMENT CO.** **CALIFORNIA.**

Office: San Francisco, Cal. Lands, 14 claims near Sisson, Siskiyou Co., Cal. No returns, and it cannot be learned that any serious mining has been attempted.

**MOUNT FISHER PROPRIETARY CO.** **AUSTRALIA.**

Was planning to build a smelter in 1902, but no returns secured.

**MOUNT FLORA MINE.** **AUSTRALIA.**

Mine office: Mackey, Queensland. Made 17 tons of copper in 1901. No returns secured and property supposed to be idle.

**MOUNT FRASER COPPER MINES, LTD.** **AUSTRALIA.**

Offices: 5-6, Great Westminster St., London, E. C., Eng. Mine office: Springfield, County Bathurst, Orange Division, New South Wales. A. A. Fraser, chairman; G. Addison Scott, secretary. Capital, nominal, £7,500. Lands, the Springfield claims, county Bathurst, held under mining lease. Mines closed, October, 1901, after securing a very small production.

**MOUNT GARNET FREEHOLD COPPER & SILVER MINING CO., LTD.** **AUSTRALIA.**

Offices: Finsbury House, London, E. C., Eng. Australian office: 47, Queen St., Melbourne, Victoria. H. Patterson, chairman; J. Moffat, managing director; J. W. Ashcroft, general manager; J. M. Potter, mine manager; E. Habben, secretary in England; T. Rollason, secretary in Australia. Company registered, December, 1898, in Victoria. Capital, nominal, £200,000; issued, £150,000. An issue of debentures has been authorized. Lands, 60 acres freehold and 152 acres leasehold at Mt. Garnet, Herberton, Queensland, carrying copper, silver and zinc ores. This is much the most important copper property in Queensland, and was working about 500 men during the first half of 1902. Company has a smelter with 2 furnaces, put in blast July, 1901. Production for 1901 was 1,884 tons copper and 389,669 oz. silver, secured from the smelting of 35,616 tons of ore. Property has been greatly hampered by lack of adequate transportation facilities, but a railroad from Lappa Lappa to

Mt. Garnet was completed in the summer of 1902. At last accounts the mine was making 175 to 275 tons of refined copper per month, and is evidently destined to become one of the largest producers of Australia.

**MOUNT GARNET & CHILLAGOE EXPLORATION. AUSTRALIA.**

A property of 363 acres in the Mt. Garnet district, Queensland, on which more or less development work has been done.

**MOUNT JUKES PROPRIETARY MINING CO. TASMANIA.**

Address: care of T. L. Hood, agent, Hobart, Tasmania. Owns lands in the Mt. Jukes field, Tasmania, and is driving a tunnel to prove the run of copper-bearing rock opened higher on the hill.

**MOUNT LYELL MINING & RAILWAY CO., LTD. TASMANIA.**

Offices: Finsbury House, London, E. C., Eng., and 39, Queen St., Melbourne, Australia. Mine office: Gormanston, Montague Co., Tasmania. B. Kelly, chairman, and W. Knox, vice-chairman, Melbourne; F. Dutton, chairman, London; Robert C. Sticht, general manager; A. Mellor, secretary at Melbourne; E. Habben, secretary in London; Hon. N. J. Brown, agent, Hobart, Tasmania. Capital, nominal, £900,000, issued £825,000, shares £3 par. Is a regular dividend payer. Property, 395 acres of mining lands and 40-acre smelter site, at Gormanston, Montague Co., Tasmania, also quartz and limestone quarries for flux, and railway 37½ miles from Queenstown to Regatta Point, Macquarie Harbour, Tasmania. Has absorbed the mines of the South Tharsis, Royal Tharsis and King Lyell companies. Employs about 2,000 men in operating its mines, smelters and railroad. Has a coking plant of 50 ovens at Port Kembla, N. S. W. Production was 9,132 tons of fine copper for the year ending June 30, 1901. For the quarter ending June 30, 1902, the company smelted 92,948 long tons of ore, producing therefrom 1,870 tons of copper, 171,133 oz. of silver and 5,556 oz. gold.

This company began production in 1896. The ore bodies lie between a conglomerate foot and a schistose hanging, consisting of a series of lenses 100′ to 300′ wide, which run to 1,000′ in length and are of unknown depth. The mine is worked open-cast. The ore bodies are essentially massive iron pyrites, carrying about 15% chalcopyrite and assaying, for the entire body, about 2.5% copper, 2 oz. silver and 1⅛ dwts. gold per ton, but the portions treated are richer, the higher grade ores occurring mainly as bunches on the footwall side, some of these running as high as 20% copper with very large values in gold. Property has a good water-power, which is partially utilized.

Company has a smelter on the western slope of Mt. Lyell, about 1½ miles from the mine, to which ore is sent by aerial tram, also a smelter at Sydney, N. S. W., which uses the pyritic system, this being the largest plant of this kind in the world. The product is blown to blister copper assaying 98% to 99%, and carrying an average of 65 oz. silver and about 5 oz. gold per ton, this being sent to the Baltimore Copper Smelting & Rolling Co., of Baltimore, Md., U. S. A., for electrolytic refining.

**MT. LYELL BLOCKS CORPORATION, LTD. TASMANIA.**

Offices: 72, Bishopsgate St., London, E. C., Eng., and 47, Queen St., Melbourne, Australia. C. S. Beale, secretary in London; Thomas Rollason, secretary in Melbourne; T. Taylor, mine manager; Hon. N. J. Brown, agent, Hobart, Tasmania. Capital, £300,000. Property, 133 acres on Mt. Lyell, Montague Co., Tasmania. Ore is sent to the Mt. Lyell Mining & Ry. Co.'s smelter for reduction. Native copper has been found in an argillaceous schist in sufficient quantity to justify concentration; principal ore bodies are sulphides of low grade. Production, is small. Mine employed 41 men, at last accounts from Tasmania, October, 1902.

**MOUNT LYELL-COMSTOCK COPPER CO., LTD.** **TASMANIA.**

Offices: 153-5, Leadenhall St., London, E. C., Eng., and Equitable Bldgs., Collins St., Melbourne, Australia. H. McDonald, chairman; T. Urquhart, London secretary; N. Madden, Melbourne secretary; T. L. Hood, agent, Hobart, Tasmania. Capital, nominal, £500,000; issued, £400,000. Property, 93 acres on Mt. Lyell, Tasmania. At last accounts no work was in progress.

**MOUNT LYELL CONSOLS.** **TASMANIA.**

Offices: Equitable Bldgs., Collins St., Melbourne, Australia. J. P. Lonergan, chairman; N. Madden, secretary; H. S. Muir, mine manager; D. J. Mackay & Co., 138, Leadenhall St., London, E. C., Eng., British agents. Organized under laws of Victoria, with capitalization £126,000. Property, 50 acres on Mt. Lyell and 40 acres on Mt. Darwin, Tasmania. Only prospecting work is in progress.

**MOUNT LYELL COPPER ESTATES, LTD.** **TASMANIA.**

Offices: 85, Gracechurch St., London, E. C., Eng. N. Cohen, chairman; F. W. Eccardt, secretary. Mylius Cohen, W. G. Browne, A. G. D. Bernacchi, J. Gillespie and W. P. Henderson, directors. Lands comprise 4 leases of 142 acres in the Mt. Lyell district of Tasmania. All operations suspended.

**MOUNT LYELL EXTENDED CO.** **TASMANIA.**

Offices: 138, Leadenhall St., London, E. C., Eng., and Equitable Bldgs., Collins St., Melbourne, Australia. J. P. Lonergan, chairman; J. P. Madden, secretary at Melbourne; J. M. Taylor, secretary at London. Capital, nominal, £150,000. Property, 30 acres on Mt. Lyell and 80 acres on Mt. Darwin; latter being prospected.

**MOUNT LYELL NORTH CO.** **TASMANIA.**

Offices: 153, Leadenhall St., London, E. C., Eng. No returns secured.

**MOUNT LYELL SOUTH CO.** **TASMANIA.**

Offices: 153, Leadenhall St., London, E. C., Eng. No returns secured.

**MOUNT LYELL TASMAN COMSTOCK GOLD, SILVER, LEAD & COPPER MINING CO., LTD.** **TASMANIA.**

Office: Launceston, Tasmania. C. H. F. Shern, agent. Was employing 25 men in prospecting and development work, in July, 1902.

**MOUNT LYELL WEST CO.** **TASMANIA.**

Offices: 16, St. Helens Pl., London, Eng. No returns secured.

**MOUNT MORGAN COPPER MINING CO.** **AUSTRALIA.**

Mine office: Mt. Morgan, Queensland, Australia. S. Phillips, manager. Has four shafts and upwards of 1,000′ of underground openings. Was employing 10 men in development work at last accounts.

**MOUNT PLEASANT MINE. AUSTRALIA.**

Mine office: Cobar, Robinson Co., N. S. W., Australia. Works pockets of chalcocite, chalcopyrite and carbonate copper ores, which are sent to the Cobar plant for smelting. Is a small producer only.

**MOUNT ST. HELEN'S CONSOLIDATED MINING CO. WASHINGTON.**

Office: Marquam Bldg., Portland, Ore. Mines at Spirit Lake, via Castle Rock, in the St. Helen's district of Skaminia Co., Wash., 50 miles from Portland. Employs 25 men. Organized 1902, under laws of Oregon, with capitalization $1,800,000, shares $1 par, non-assessable. Hugh McGuire, president; Thos. Prince, vice-president; Chas. A. Marsh, secretary; Dr. Henry Waldo Coe, treasurer. Directors are preceding officers, C. W. Sherman, J. K. Locke, L. O'Connor and A. C. Smith. Robert A. Foster, general manager. Lands, 2 patented and 33 unpatented claims, area 600 acres, also 40-acre millsite. Has 8 fissure veins, of which 5 are being given attention. Ore occurs as sulphides in veins, 1' to 12' wide, in a mineralized zone of low-grade ore several hundred feet in width, the richer portions assaying 9% copper, occasional lead, $8 gold and 40 oz. silver per ton. Has tunnels of 350' and 420', also surface cuts. Estimated ore blocked out for stoping, 20,000 tons. Company uses water power, with 80-h. p. Pelton wheel; has air compressor and drills, also sawmill, all installed late in 1902. Company is planning a concentrator of 50 to 100 tons daily capacity. Mines will begin shipping in the spring of 1903. Low-grade ores have shown concentration of 18 into 1. Nearest railway 40 miles, but three lines are surveyed into the district.

**MOUNT SHASTA GOLD MINES CORPORATION. CALIFORNIA.**

Office: 431 Stock Exchange, Chicago, Ill. Mine office: Redding, Shasta Co., Cal. Delos P. Phelps, president and treasurer; Frank E. Ware, vice-president and general manager; H. S. Gillett, secretary; R. F. Harrison, superintendent; J. K. Keating, smelter superintendent. Organized under laws of South Dakota, with capitalization $20,000,000, shares $1 par, non-assessable. Present company is a reorganization of the Mt. Shasta Gold Mining Co., which paid a small dividend in 1899. Capitalization was increased to permit absorption of the Bully Hill mine in October, 1902, Capt. J. R. De La Mar selling his Bully Hill and other copper holdings in Shasta Co., and also his Gold Mountain gold mine in San Bernardino Co., Cal., taking payment in stock of the Mt. Shasta Gold Mines Corporation. Stock is to be listed on the Boston Exchange. Lands include upwards of 4,000 acres of copper and gold mining property, several thousand acres of timber lands, several townsites, sundry water rights, etc.

Company is operating the Mt. Shasta gold mine, main shaft 350', retimbered 1902 and to be sunk to a depth of 750'. New machinery installed in 1902 includes hoist good for one-half mile depth, new air compressor, power drills, etc. Property has area of 620 acres, showing about 25 quartz veins. Main vein is a fissure with clay gouge in a chloritic schist, running 5' to 15' wide, with a pay-streak of 1' to 2', which gave average returns of $28 per ton from 4,000 tons treated at the Keswick smelter. Balance of vein-matter is quartz and schist, carrying from a trace to $50 gold per ton, and averaging

$6 to $7 per ton. Mine has about 1 mile of underground openings, and a 6-stamp mill with monthly capacity of 900 tons, which is to be largely increased. Works about 35 men, and nets about $2,000 per month.

The Gold Mountain mine, in San Bernardino Co., Cal., has about 1,000 acres and carries a vein estimated by John A. Church to be 400′ to 500′ wide and 1 mile long, judging by the outcrop. This is worked as a quarry, and shows about 4,000,000 tons of free milling quartz, estimated to carry an average of $4 to $5 gold per ton. Has a 40-stamp mill, and ore to feed it can be blasted down by a dozen men or less. Has a water supply adequate for treatment of 2,000 to 3,000 tons daily, and a water power of about 1,000 h. p. is available for development. Mr. Church estimates that the total cost of mining and milling should not exceed $1.50 per ton with a 100-stamp mill. Company contemplates adding 100 stamps to present equipment.

The copper mines and claims of the Mt. Shasta Co. include the Bully Hill, Summit & Graves, McClure group, United Copper and Winthrop. Bully Hill, which is the site of the principal development, rises 1,200′ above the surface of the surrounding country, having a diameter of about 4,000′. It is composed of eruptive rocks, principally rhyolite, and has 3 mineral zones, running approximately north and south, with indications of 2 additional zones. The ore occurs in lenses, having a kaolin gouge of 1′ to 30′ on one or both walls. Veins are holding in width and values to the depths yet opened, and are likely to prove persistent and of good grade to great depth. The main chutes or lenses have numerous feeders, from a few inches to 30′ wide, carrying 2% to 20% copper, with from a trace to $15 gold per ton. The lenses are 20′ to 300′ long horizontally, 2′ to 40′ wide, and one has been followed to a depth of 700′. The country rock is more or less impregnated with mineral values and in the center of the hill for a distance of 200′ to 500′ there is a zone carrying about 3% copper and $2 gold and silver per ton, with siliciou gangue, this being the only considerable body of silicious ore yet opened in the district, and being highly desirable for a flux to use with the iron-copper sulphides of the district. The outcrop is a heavy gossan capping, usually averaging a low but workable grade of gold and silver, with occasional patches running up to $200 gold and 500 oz. silver per ton. The copper zone is reached at a depth of 20′ to 150′ from the surface of the outcrop. The zone of secondary enrichment, at a depth of 100′ to 200′, carries high values in chalcocite, with some cuprite and malachite, ranging up to 20% copper and $20 gold and silver per ton. Below the secondary zone come the unaltered iron-copper sulphides, assaying up to 9% copper, with small gold and silver values and carrying small quantities of zinc.

The Bully Hill mine, 20 miles northeast of Iron Mountain, was opened as a gold mine and worked the gossan with rather indifferent results, until copper ores were developed at depth. The Bully Hill property has 18 patented claims, area 213 acres, and is equipped with complete steam and electric plants, air compressors, drills, etc., with about 5 miles of underground openings. The mine is timbered with square sets and opened mainly by tunnels, giving cheap ore extraction. The developed ore bodies range 4′ to 100′

wide, averaging 30′. In No. 3 shaft there is an underground station 100′ square, containing powerful hoisting and pumping machinery.

The holdings of the Mt. Shasta on Bully Hill include the Michigan, McClure and miscellaneous claims, in addition to the Bully Hill mine proper, giving a total area of about 1,200 acres. These miscellaneous claims had about half a mile of tunnels previous to the absorption of the Bully Hill mine, showing several ore bodies 15′ to 70′ wide and a number of smaller veins running 3′ to 8′ in width, the main ore body averaging 38′ wide, and giving good assay values in copper, gold and silver. The Winthrop mine is at Copper City, 2 miles from Bully Hill, and has had but little work. The United Copper group of 20 claims, area 400 acres, lies near the Trinity and Balaklala mines, at Copley, and has about 250′ of tunnels, showing ore in a contact vein between rhyolite and quartzite, this ore body being extensive, but of low grade.

The Summit and Graves properties are west of the Sacramento river, 7 miles from Kennett, in the Iron Mountain section of the Shasta county belt, and are opened by tunnels, showing sundry ore bodies, one of which is a 50′ vein of low-grade concentrating ore, another being a 40′ vein of 3% copper ore carrying $1 to $2 gold and silver per ton, while the third is a 35′ vein of sulphide ore giving assays of 7% copper and $2 to $3 gold and silver per ton. About 600′ of development work has been done on these groups.

The Bully Hill smelter, which cost about $200,000, has a capacity of 125 to 150 tons daily, and is to be enlarged to 500 tons. The mill is terraced, permitting the handling of material by gravity. The roast-stalls are in series, making a structure 39x310′ with 90′ stack. There are 2 McDougal calcining furnaces and a 42x120″ blast furnace. There are 2 stands of converters with 5-ton shells of 68x98″, matte being handled by electric cranes. The furnace charge is usually one-half raw and one-half calcined ore, the product being 98% blister copper, which is refined by the Delamar works at Carteret, N. J. The smelter also has a well-fitted machine shop.

The company plans building a 2,000-ton smelter midway between its mines in the eastern and western parts of Shasta county. Owing to the Mt. Shasta company's mines having large bodies of low-grade silicious ores, which are lacking in the Mountain, Balaklala, Trinity and other copper mines of the district, it is thought that arrangements can be made for very extensive custom smelting in addition to the reduction of the company's own ores. The Mt. Shasta is a big property, with promise of becoming a large producer, and is being managed and developed with vigor.

**MOUNT STERLING MINE. CALIFORNIA.**

Owned by Kneiper & Ashbrook, in Section 10, Town 12 South, Range 23 East, Fresno Co., Cal. Developing by tunnel at last accounts.

**MOUNT THECKLA MINE. AUSTRALIA.**

At Kangaroo Hills, Queensland. Opened 1900. Made 23 tons of copper and 6,315 oz. silver in 1901. Owners understood to contemplate building a smelter.

**MOUNT WASHINGTON COPPER CO. MARYLAND.**

Office and mines: Mt. Washington, Baltimore Co., Md. I. Yellott, receiver. Foreclosure proceedings were begun, November, 1902, for sale of property under a $35,000 mortgage. Is an old property, closed down 1866, reopened 1901, in which latter year several carloads of ore were shipped to smelters. Vein carries bornite and chalcopyrite, slightly auriferous and argentiferous.

**MOUNT ZIRKEL COPPER MINING CO. COLORADO.**

Office: 240 La Salle St., Chicago, Ill. Mine office: Pearl, Larimer Co., Colo. Employs 16 men. Organized 1901, under laws of Wyoming, with capitalization $1,000,000, shares $1 par, non-assessable. Wm. A. McGuire, president; W. B. Watters, vice-president; E. B. Boisot, secretary and treasurer; L. D. Godshall, general manager. Directors are preceding officers and W. H. Scott. J. J. Mackey, superintendent. Lands, 7 claims, area 60 acres, partly patented, also millsite of 5 acres, in the Big Horn district of Larimer Co., Colo. Has a 75′ fissure vein, carrying sulphide ore estimated by company to average 20% copper, $10 gold and 4 oz. silver per ton, which is being opened by a 250′ shaft and drifts. Has steam boiler, hoist and pump. Nearest railroad, Union Pacific, 65 miles from mine; nearest smelter, at Encampment, 20 miles. Company contemplates expending $30,000 on development work in 1903.

**MOUNTS SICKER & BRENTON MINES, LTD. BRITISH COLUMBIA.**

Property consists of 2 claims on Mt. Sicker and 6 claims on Mt. Brenton, in the Victoria division of British Columbia. About 350′ of opening work was done in 1901, and some buildings erected. No returns secured for 1902.

**MOUNTAIN COPPER CO. CALIFORNIA.**

Offices: 3, Lombard St., London, E. C., Eng. Mine office: Keswick, Shasta Co., Cal. Normal force, about 1,200 men—300 at the mine and 900 at the smelter and shops in Keswick. W. Keswick, chairman; Sir Andrew Noble, W. Scott, C. W. Fielding, W. D. Cruddas, A. Fellows and H. J. Wenham, directors. A. N. Frewen, secretary; Lewis T. Wright, mine manager; W. H. Haskins, superintendent; A. S. Haskell, smelter superintendent; J. J. Murray, assistant smelter superintendent; Vivian Bond & Co., of New York, American agents. Registered Dec. 1, 1896. Capital, £250,000, in £1 shares with £750,000 debentures, in £3 bonds bearing 6% interest, the debentures having been issued to shareholders in lieu of stock, to provide for the exhaustion of the mine, this being really a method of amortization, and to be commended for its fairness. Dividends were 5s. per share in 1897; 7s. 6d. in 1898; 20s. in 1899; 16s. in 1900 and 10s. in 1901. Net earnings of 1901 were £380,144, from which dividends of £125,000 were paid and £250,000 carried into reserve. Production of refined copper in 1900 was 22,442,000 pounds.

This property was originally worked as a gold-silver mine, and was bought in 1895 by the Mountain Mines Syndicate, Ltd., which was succeeded by the present company on Jan. 1, 1897. The ores change at depth from gold-silver to copper, gold and silver values being found mainly in the gossan outcrop. The company owns extensive tracts of mineral lands in the vicinity of Iron Mountain, Shasta Co., Cal., also a smelter at Keswick, and the New Jersey Metal Refining Works, Ltd., at Elizabeth, N. J.

There is a 300′ gossan outcrop on Iron Mountain, above the mines, this carrying fair gold and silver values. At depth the ore changes to chalcopyrite in pyrrhotite, giving an excess of iron and being refractory in smelting. The ore occurs in immense lenses, usually underlying the gossan, but sometimes in the rhyolite without surface indications of mineral values. The ore carries an average of a little less than $1 gold and about 2 oz. silver per ton, and is rich in sulphur and notably free from arsenic, antimony, bismuth and other deleterious elements, but is deficient in silica. Returns of copper from ore smelted have declined from 7.5% in 1897 to a trifle under 5% for the first half of 1902. Production has increased from 5,958 long tons in 1897 to 11,443 long tons in 1900. The mine is opened by tunnels, and chambers are not timbered, being dry-walled with waste rock. The main lense runs 100′ to 400′ wide, about 800′ long and 600′ deep, containing about 1,750,000 tons of ore of all grades. The ore reserves are upwards of 1,000,000 tons, and the reserves blocked out for stoping on March 1, 1902, amounted to 538,635 tons. Three diamond drills are used steadily for exploration. The property has steam, water and electric power.

The smelter, at Keswick, 11 miles from the mine, is known as the Keswick Smelting Works, and has a nominal capacity of 1,000 tons daily, with an actual capacity of about 1,250 tons. It has 5 water-jacket blast furnaces, 1 Ropp roasting furnace, 11 Wright circular calcining furnaces, 3 stands of converters, 3 briquetting machines for flue dust, and a complete sampling plant, with extensive machine shops and foundry. Stall-roasting was replaced in 1899 by heap-roasting in open air, 8 to 10 weeks being required for roasting. This process leaves 7% of sulphur in the calcined ore, against 45% in the raw ore. The fines and a large part of the other ores from the roast heaps are calcined, being loaded from the roast-heaps by steam shovels. The smelter is fitted with hydraulic elevators and the first fusion gives a 20% to 30% matte, which is roasted and then blown up to white metal, after which it is bessemerized and turned out as blister copper running 98% to 99% fine, going thence to the refinery on the Atlantic seaboard.

Electric power generated 80 miles distant is used at a cost of three-fourths of a cent per horse-power hour. The smelter does custom work, buying gold ores of all grades, which are used in fluxing the ores from the Iron Mountain mine. An electric railway takes ore from the mines to the ore bunkers on the steam railway, which descends 2,000′ in the 11 miles between the mines and the smelter.

A fire which begun in the fall of 1901 in the lower levels of the mine escaped from control in October, 1902. This was extinguished by water brought two miles through a 5′ main, the mine being flooded. The Smeltermen's Union begun a strike in November, 1902. The London management has cabled the local officials to hold out for a year if necessary and as the strikers are also very determined, protracted idleness may result. The Union demanded recognition and the reinstatement of several members discharged, but asked no concessions regarding wages or hours. The company will probably make a determined effort to break the strike with non-union labor, early in 1903, unless the union previously recedes from its present determined stand, which is not probable.

This company has made a great success of a property for which nothing but failure was predicted by those best acquainted with the mine and district.

**MOUNTAIN VIEW COPPER CO. OREGON.**

Incorporated July, 1902, under Oregon laws, with capitalization $1,200,000, by W. J. McNamara, W. G. Olmstead, et al. Property supposed to be at Kirby, Josephine Co., Ore. No returns secured.

**MOURGOUL RIVER COPPER CO., LTD. RUSSIA.**

Offices: 3, Princes St., London, E. C., Eng. Registered September 19, 1901, with capital, nominal, £500,000. Property, copper and other mineral lands, in the Mourgoul Valley, Artoin district of the Causacus, Russia. No returns secured.

**SOCIETE ANONIMA DE MOUZAIA. ALGERIA.**

Offices: Rue Petites-Ecuries, 20, Paris, France. Company owns mines of copper and iron, of which the principal property is the Mouzaia copper mine, department of Alger, Algeria. This formerly worked antimonial gray ores, and was once an important producer. Idle since 1899.

**LOS MUERTOS MINING CO. MEXICO.**

Mine office: Velardena, Durango, Mexico. Carter Barker, superintendent. Has copper, silver and lead ores, developed by shaft and tunnel. Mine is said to be equipped with steam power and employing a considerable force.

**MUNGANA (CHILLAGOE) MINING CO., LTD. AUSTRALIA.**

Offices: 39, Queen St., Melbourne, Australia, and Finsbury House, London, E. C., Eng. C. W. Chapman, chairman; E. J. J. Rodda, mine manager; C. L. Hewitt, secretary at Melbourne; E. Habben, secretary at London. Registered March, 1901, in Queensland. Capital, £125,000, shares 5 shillings par. Property, 293 acres leasehold, about 100 miles from Mareeba, North Queensland, containing copper, silver and lead ores. Has 6 shafts and was working 100 men at last accounts. New air compressor and steam plant installed in 1902. Property makes a good showing in developed ores and should become a considerable producer when given a railroad to connect with the smelter at Chillagoe.

**MUNROE-THOMPSON ORE REDUCTION CO. NOVA SCOTIA.**

Office: 12 Pearl St., Boston, Mass. Mine office: Wentworth Centre, Cumberland Co., N. S. Mine was employing about 20 men, in November, 1902. Organized 1901, under laws of Maine, with capitalization $1,000,000, shares $1 par, non-assessable. E. R. Gregory, president; L. L. Sellew, vice-president; E. F. Morse, secretary; J. J. Reilly, treasurer and general manager. Directors are preceding officers, C. C. Munroe, Geo. E. Sanborn and T. M. Ogilvie. C. C. Munroe, superintendent. Mining lands, 15 square miles, with 4-acre mill site, at Wentworth Centre and Malagash Point, Cumberland Co., Nova Scotia, and in Melbourne, Quebec. Claims show 15 ore bodies, of which three are being developed. Main ore body is a blanket formation, given as 100′ wide and 5′ thick, with an estimated value of 7% copper and 2 oz. silver per ton. Ore is tetrahedrite. About 500 feet of underground openings, with 100,000 tons of ore blocked out for stoping, according to company's estimate. Steam power equipment. Concentrator under construction. Smelter, at Wentworth Centre, one mile from mine, has a 150-ton water-jacket furnace, Blake crusher, 100-ton pulverizer, 100-ton rotary roaster for leaching plant and 10 large lixiviation tanks. Mill and smelter plant include buildings of 25x100′, 25x50′, 30x75′ and 30x30′ with sundry sheds and outbuildings.

**MURRAL-ISABEL MINES CO.** **COLORADO.**

Mine office: Parkdale, Fremont Co., Colo. W. H. Murray, superintendent. Ores carry gold, silver, lead, copper and zinc. Has steam power equipment and concentrator. Employs about 40 men.

**MUTOOROO MINES.** **AUSTRALIA.**

Address: care of P. J. Winch, Hindley St., Adelaide, South Australia. Lands, 320 acres of leasehold near Cockburn, New South Wales. Property has paid small dividends. Ore occurs in lenses averaging 6.5% copper.

**MUTUAL GOLD & COPPER MINING CO.** **WYOMING.**

Mine office: Rawlins, Wyo. Organized 1900, with capitalization $300,000, shares $1 par. L. E. Armstrong, secretary. Lands, 80 acres, in the Battle Lake district of Carbon Co., Wyo. Has 4 shallow shafts and 200′ tunnel. Ore body estimated at 8′ wide. Supposed to be idle.

**MYSTIC SHRINE GOLD & COPPER MINING CO.** **UTAH.**

Office: 612 McCornick Bldg., Salt Lake City, Utah. Mine office: Bingham Canyon, Salt Lake Co., Utah. Organized 1900, under laws of Utah, with capitalization $1,000,000, shares $1 par. E. W. Young, president and general manager; H. B. Cole, vice-president and secretary; W. S. McCornick, treasurer. Directors are preceding officers, Jas. A. Miner, F. W. Gardener and Dr. W. Burrows. F. Schefski, superintendent: Vivian P. Strange, mining engineer. Lands, 8 claims, 2 patented, area 137 acres, in West Mountain or Bingham district of Salt Lake county, having 11 fissure and contact veins, of which one is being developed, this showing sulphide and carbonate ores assaying 5% copper, 40% lead, $2 gold and 15 oz. silver per ton. Has incline shafts of 60′, 100′ and 175′, also 7 tunnels, longest 500′, and about 2,500′ of underground openings. Has steam hoist and pump, smithy, etc. For 1903 will continue driving lower tunnel and crosscut to main ore body.

**NACOZARA MINING & REDUCTION CO.** **MEXICO.**

Office: Los Angeles, Cal. Fred Ohlmeyer, president; W. A. Carney, vice-president; J. Irving McKenna, secretary. Company organized July, 1902, to take over a copper-gold-silver property about 7 miles from the Nacosari mine at Moctezuma, Sonora, Mexico. No returns secured.

**NAFVERBERGS KOPPERVERK.** **SWEDEN.**

A small property in Kopperbergs län, Sweden, which made 361,800 kilograms of low grade matte in 1902.

**NAHMINT MINING CO.** **BRITISH COLUMBIA.**

Owns the old Hayes mine, at Alberni, Vancouver district, B. C. Has about one mile underground openings and surface improvements include a one-mile automatic tramway. Worked 60 men in 1901; closed down in 1902. American consul reports veins nearly exhausted. Letter addressed to company returned unclaimed, October, 1902.

**COMPANIA MINERA DE NALTAGUA. CHILE.**

Operates the Naltagua mine, opened 1898, in the department of Melipilla, Chile. Company was preparing to become a regular producer at last accounts.

**NAMAQUA COPPER CO., LTD. CAPE COLONY.**

Offices: 3, Fenchurch St., London, E. C., Eng. Mine office: Concordia, Little Namaqualand, Cape Colony. F. J. Mirrielees, manager and ex-officio chairman; F. Phillips, mine manager; A. W. Outram, secretary. Registered, April 23, 1888. Capital, nominal, £200,000, shares £2 par. Gross receipts for 1900 were £144,087; net profits, £56,027. Has been a considerable dividend payer since formation of company. Ore output for 1901 was 11,584 long tons of 21 cwts.

Lands, 680 acres, at and near Concordia, Little Namaqualand, held on leasehold at royalty of 2s. 6d. per ton of ore produced. Mines are the Tweetfontein with 7 shafts; Wheal Julia, with 3 shafts; Flat mine with 1 shaft; Jubilee and Henderson mines with 2 shafts each; New East Centre mine, with 1 shaft, and Prospect mine with 2 shafts. The Jubilee, Henderson and Prospect mines have been idle during 1902, on account of the low price of copper. Has concentrators at the Flat mine and New East Centre mines, dressing ore up to 25% to 35% copper, for shipment to British smelters, via Port Nolloth. Ore occurs as high grade chalcopyrite, with intrusive greenstone traversing granite. Mine has considerable ore reserves. Operations are somewhat hampered by expensive transportation and work was greatly interrupted during the Boer war.

**NAMAQUA VENTURE SYNDICATE. CAPE COLONY.**

Is developing a copper property of fair promise at Wittwater, Little Namaqualand, Cape Colony, South Africa.

**NANCY HANKS MINE. MONTANA.**

At Garnet, Granite Co., Mont. Samuel Ritchie, owner; C. L. Parker, lessee. Has gold-silver-copper ores, opened by shaft. Steam power. No returns secured.

**NANCOT COPPER CO. NEW MEXICO.**

Office: presumably Albuquerque, N. M., but letter sent to that address returned unclaimed, November, 1902. Organized October, 1902, under laws of New Mexico, with capitalization $1,000,000, shares $1 par.

**NAPA COUNTY COPPER MINING CO. CALIFORNIA.**

Offices: 1206 Market St., San Francisco, Cal. Owen Wade, president; F. J. Taylor, secretary and treasurer. Incorporated August 22, 1902. Owns a claim 13 miles south of Middletown, Napa Co., Cal., on which a 400′ tunnel has been driven. Idle at last accounts.

**NAPOLEON MINE.** **CALIFORNIA.**

At Copperopolis, Calaveras Co., Cal. Under bond to Lewis and Ben Williams; owned by Josephine H. Sullivan. This is the oldest copper mine in California, and was once a considerable producer. The vein channel is 100′ wide and ranges from diabase to talcose schist, the ore bodies occurring in lenses up to 20′ wide. Shaft is 325′ deep. Ores, principally sulphide, with a considerable sprinkling of carbonates and oxides. New shaft is being sunk west of the old workings. Considerable copper has been produced recently, by cementation from leachings of the old dumps.

**NASHVILLE MINE.** **COLORADO.**

Mine office: Idaho Springs, Clear Creek Co., Colo. Was showing an 8″ vein of solid bornite, at a depth of 90′, in December, 1902. No returns secured.

**NATIONAL COPPER CO.** **WYOMING.**

Office: Douglas, Carbon Co., Wyo. Incorporated July, 1902, with capitalization $250,000. Frank Tinkham, president; G. W. Johnson, secretary; H. C. Paul, general manager. Company owns several claims near Guthrie, Wyo. No returns secured.

**NATIONAL COPPER MINING CO.** **UTAH.**

Office: 400 D. F. Walker Bldg., Salt Lake City, Utah. Mine office: Cisco, Grand Co., Utah. Capitalization $100,000, shares 10 cents par. F. E. Smith, president; W. H. Tibbals, vice-president; C. E. Payton, secretary and treasurer. Lands, about 115 acres, in La Sal Mountains, Sonoma district of Grand county. Ore assaying 9.5% copper, traces of gold and 17.5 oz. silver per ton has been taken from a fissure vein traversing sandstone. No returns secured; property presumably idle.

**NATIONAL COPPER ORE CO.** **VIRGINIA.**

A New York corporation that is working deposits of cuprous pyrites at Garrisonville, Stafford Co., Va. No returns secured.

**NATIONAL MINING CO.** **MICHIGAN.**

Office: 15 Congress St., Boston, Mass. D. L. Demmon, secretary and treasurer. Mine adjoins the old Minnesota, now the Michigan mine, at Rockland, Ontonagon Co., Mich. Idle since 1893. Mas produced nearly 6,000 tons of copper, and has paid dividends of $320,000. Fully described in 1902 edition.

**NATIONAL SMELTING CO.** **SOUTH DAKOTA.**

Office: Rapid City, Pennington Co., S. D. Mines gold, silver and copper ores. Has a large smelter and employs 200 men or more. A small amount of copper is secured as a by-product.

**LA NATIVIDAD MINING CO.** **MEXICO.**

Office: 17–21 Park Row, New York. Mine office: Coapa, Michoacan, Mexico. Capitalization $1,500,000, shares $1 par. J. B. Quin, president; Clark G. Drum, vice-president; M. L. Ward, secretary and treasurer. H. W. West & Co., fiscal agents. Lands, 100 pertenencias, area 247 acres, near Coapa, bought late in 1902. Vein matter is alleged to run as high as 85% copper, with large assay values in silver.

**NELSON COPPER FIELDS, LTD.** **BRITISH COLUMBIA.**

Offices: 57, Moorgate St., London, E. C., Eng. H. Shepherd Cross, chairman; C. S. Good, secretary. Capital, nominal, £100,000. Property consists of the Birdseye group, area 344 acres, on Morning Mountain, near Nelson, B. C. No returns secured.

**C. NEUMANN & CO.** **CAPE COLONY.**

This firm is developing copper properties in Little Namaqualand, Cape Colony.

**NEVADA CONSOLIDATED COPPER & GOLD MINING & MILLING CO.** **NEVADA.**

Office: 506–31 State St., Boston, Mass. Mine office: Yerington, Lyon Co., Nev. Organized under laws of Maine, with capitalization $1,000,000, shares $5 par. Jas. P. Niles, president and general manager; J. Howard Thurlow, vice-president; Horace P. Hunt, secretary; Jas. D. Niles, treasurer. Lands, 18 copper claims in Lyon Co., also 12 gold claims in Lincoln Co., Nev. Company was planning to start work in 1902 at the McConnell mine on a considerable scale. Has steam and electric power. No returns secured.

**NEVADA COPPER CO.** **NEVADA.**

Merged in Nevada Bell Copper Mining & Reduction Co., in 1902.

**NEVADA DEVELOPMENT CO.** **NEVADA.**

Mine office: Azurite, Churchill Co., Nev. Theodore H. Lowe, superintendent. Was prospecting with small force at last accounts.

**NEVADA GOLD & COPPER MINING CO.** **NEVADA.**

Office: Parrot Bldg., San Francisco, Cal. No returns secured.

**NEVADA BELL COPPER MINING & REDUCTION CO.** **NEVADA.**

Office: 850 Drexel Bldg., Philadelphia, Pa. Mine office: Lovelock, Humboldt Co., Nev. Organized 1902, under laws of Nevada, with capitalization $5,000,000, absorbing the Nevada Copper Co. and the Bell Mare Mining & Smelting Co. C. W. Sweitzer, president; H. H. Barbee, vice-president; A. P. Platt, secretary and treasurer. Lands, about 500 acres, on which considerable development has been secured. The Bell Mare tunnel, about 500′ long, is to be continued to a length of 1,500′, to cut the ore body found in the Copper King tunnel. Ore bodies are said to be large, but of low grade, averaging about 4% copper, and occurring as replacements in a formation of andesitic porphyry. Has a 60-ton smelter, built by the Nevada Copper Co.; company is planning to replace this with a much larger plant.

**NEW AMERICAN MINING & MILLING CO.** **UTAH.**

Supposed to be working near Brigham, Box Elder Co., Utah, but no returns secured.

**NEW ARIO COPPER & EXPLORATION CO., LTD.** **MEXICO.**

Offices: 31, Lombard St., London, E. C., Eng. J. Hendrick, managing director; F. Richards, secretary. Capital, nominal, £100,000, in 500,000 shares of 4s. par. Property, sundry mining lands at Ario, Michoacan, Mexico. No work was in progress at last accounts.

**NEW BALLA BALLA COPPER MINES, LTD.** **AUSTRALIA.**

Offices: 6, Great St. Helens, London, E. C., Eng. T. W. Williams, chairman; Capt. J. Jeffery, mine manager; E. A. Foster, secretary. Capital, nominal, £250,000; issued, £186,000. Property, 2 mines, 11 miles from Port Balla Balla, Western Australia, and one mine 50 miles distant, with total area 120 acres. Company has a 30-ton smelter. No returns secured.

**NEW BOSTON GROUP. MONTANA.**

A group of claims in the Corbin district of Jefferson Co., Mont., on which a rich strike of silver-copper ore, assaying 12% copper and 10 oz. silver per ton, was made in December, 1902.

**NEW CALEDONIA COPPER CO., LTD. NEW CALEDONIA.**

Offices: presumably London. Mining lands are in the district of Arama, New Caledonia, and include the Pilou mine, which is 240 metres deep. Property shows carbonate and oxide ores near surface, succeded at a little depth by chalcopyrite and galena, both being more or less argentiferous. The ore is dressed to 13% to 15% copper in a 250-ton concentrator, the concentrated ore carrying 200 to 400 grams of silver per ton from the sulphide ores, while the surface ores give 2 to 4 grams per ton in gold.

**NEW CLONCURRY COPPER & SMELTING CO., LTD. AUSTRALIA.**

Offices: 116, St. Vincent St., Glasgow, Scotland. R. L. Alston, chairman; D. F. G. Meldrum, secretary. Company owns copper mines in North Queensland, which were idle at last accounts.

**NEW COLUMBIA MINING CO. IDAHO.**

Mine office: Salmon, Lemhi Co., Idaho. H. Armstead, superintendent. Is developing copper and gold ores by tunnel. Has steam power and 10-stamp mill.

**NEW ENGLAND COPPER CO. ARIZONA.**

Office: 16-62 Devonshire St., Boston, Mass. Mine office: Clifton, Graham Co., Ariz. Edw. H. Strobel, lessee; Arthur P. Ayling, president and manager; Fred T. Drake, superintendent of electrical department. Lands, 22 claims. Deepest shaft, 400′, all in ore of good grade. Has about 4,500′ of underground openings, showing promising ore bodies occurring as fissure veins, instead of the blanket veins found 3 miles distant at Clifton. Uses electric drills. Principal development is on the Copper Bullion and Solid Copper claims, with shafts about 600′ each, showing pay streak of 5′ to 6′ chalcopyrite in a vein said to be widening with depth. Ore is being stocked at the shafts, and company contemplates installation of a 200-ton smelter. Property is regarded as quite promising, and some of the ore secured is among the richest ever taken from any mine in the Clifton district.

**NEW ENGLAND GOLD & COPPER MINING CO. UTAH.**

Office: 53 State St., Boston, Mass. Mine office: Bingham Canyon, Salt Lake Co., Utah. Employs 22 men. Organized 1899, under laws of Colorado, with capitalization $1,000,000, shares $1 par, non-assessable. D. W. Williams, president; E. M. Gibson, vice-president; Geo. F. Bradstreet, secretary and treasurer; S. W. West, general manager; directors are preceding officers, J. S. Williams, Frederick Johnson and N. P. Cummings. H. M. Adkinson, superintendent; Col. E. A. Wall, mining engineer. Lands, 7 claims, 3 patented and 4 in process of patenting, area 27 acres, in the West Mountain mining district of Salt Lake Co., Utah, showing 2 fissure veins averaging 3′ in width and traced for 1,600′. Ores are sulphide; company esitimates average values at $35 per ton. Property is developed by 7,000′ of tunnels and drifts, from which $20,000 worth of ore was secured in opening. Is equipped with boilers, engines, pumps, etc. Management contemplates erecting a concentrator in 1903. Ore is sold to smelters at Salt Lake.

**NEW ENGLAND MINING CO. MASSACHUSETTS.**

Office: Greenfield, Mass. Capt. Geo. H. Davenport, general manager. Organized 1902, to develop the Bates copper property near Charlemont, Mass. Property is 2 miles west of the Davis pyrite mine, worked for the past 20 years. Vein is approximately vertical, conforming closely in dip and strike with the Savoy schist in which it occurs, and is apparently a fahlband, there being no well-defined walls, the ore occurring scattered through 15′ to 20′ of the schist. On what might be called the south wall is a vein of quartz, well mineralized, 6″ to 12″ wide, and on the north wall there is a heavy impregnation of chalcopyrite having a width of 1′ to 2′. Prospect is being opened by crosscutting and stripping, and vein has been traced about 700′.

**NEW ENGLAND & ARIZONA COPPER & GOLD MINING CO.**

Address: care of C. M. Egge, McCabe, Ariz. Organized under laws of Arizona. E. D. Fisk, president; C. M. Egge, superintendent. Lands, 5 claims, near the Silver Belt mine, in the Big Bug district of Yavapai Co., Ariz. Was doing development work in September, 1902.

**NEW ENGLAND-UTAH MINING CO. UTAH.**

Office: 1226 N. Y. Life Insurance Bldg., Chicago, Ill. Mine office: Bingham Canyon, Salt Lake Co., Utah. Was formerly known as the Last Chance group. Organized 1901, under laws of Delaware, with capitalization $1,250,000, shares $1 par. Don M. Dickinson, president; John Jay Abbott, vice-president; Chas. J. Hodge, secretary and treasurer. Directors are preceding officers, Richard R. Kenney, Lindsay R. Rogers and Jas. R. Barnes. Morris R. Hunt, general manager; E. M. Eakin, superintendent; Edw. Cutler, mill superintendent; E. P. Jennings, mining engineer. Lands, 13 claims, 9 patented, area 115 acres, in the West Mountain or Bingham district of Salt Lake Co., showing fissure and contact veins, ranging 3′ to 50′ wide, with estimated length of 3,700′ and estimated depth of 1,200′, giving average assay value of about $65 per ton. Has 7,000′ of tunnels and about 2 miles of underground openings. Has 125-h. p. boiler, 60-h. p. engine and 100-ton concentrator, with crusher, rolls, Chilean mill, Hodge jigs and tables. For 1903 company will install new hoists, compressor, and power drills, and continue underground development.

**NEW ERA MINING CO. MEXICO.**

Is developing copper claims south of La Cananea, Sonora, Mexico. Management expects to make first shipment of ore to the Selby smelters early in 1903.

**NEWFOUNDLAND COPPER CO., LTD.** **CHILE.**

Offices: St. George's House, Eastcheap, London, E. C., Eng. J. Peters, chairman; R. K. Roskilley, manager; J. Pye, secretary. Registered March 8, 1898. Capital, nominal, £250,000; issued, £67,333. Originally organized to operate the Little Bay and Lady Pond copper mines, in Newfoundland, for which £52,000 were paid in stock of the company. The Newfoundland mines are now idle and apparently abandoned, and the company is devoting attention to the Bella Vista group of mines, in the Copiapo district of Atacama, Chile. Latter mines are held on a 5-year lease expiring July, 1905, at a nominal rental and 20% royalty on net profits.

**B. NEWGASS & CO.** **SPAIN.**

Offices: 7, Lothbury, London, E. C., Eng. Firm owns silver-gold-copper mines at Arrieta and Changoa, Navarra, Spain. No returns secured.

**NEWGATE MINE.** **CONNECTICUT.**

An old property at Granby, Connecticut. Has been worked at different times during the past century, but is now idle.

**NEW MAMMOTH MINING & MILLING CO.** **UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. J. E. Beveridge, superintendent. Is developing an ore body carrying gold, silver and copper values, by shafts and tunnel. Has steam power and works a moderate force.

**NEW MEXICO COPPER MINING & SMELTING CO.** **NEW MEXICO.**

Office: Hartford, Conn. Mine office: Lucera, Mora Co., N. M. Linus Plimpton, president; Alex Harbison, vice-president; Jas. M. Thomson, treasurer; Chas. Denison, secretary. Directors are preceding officers, Henry Osborn, Wm. E. Hawks, H. A. Stearns and Kenneth K. McLaren. Organized under New Jersey laws, with capitalization $1,000,000, shares $1,000 par. Lands, 9,000 acres of mineral and timber lands near Lucera, Mora Co. Several veins are partly developed by shafts and tunnel, and show copper, gold and silver ores. Mine has steam power and an 80-ton concentrator.

**NEW MEXICO DEVELOPMENT CO.** **NEW MEXICO.**

Supposed to be opening a copper property near Fierro, Grant Co., N. M. No returns secured.

**NEW MEXICO GOLD & COPPER MINING CO.** **NEW MEXICO.**

Office: 31 Cawker Bldg., Milwaukee, Wis. Mine office: Tres Piedras, Taos Co., N. M. Organized under laws of New Mexico, with capitalization $2,500,000, shares $1 par. Edgar L. Fowle, president; H. Wegart, secretary and treasurer; Richard Cole, superintendent. Lands, 7 claims, area about 140 acres, in the Bromide district of Taos county. Development is on the Strawberry, Climax and Jack Pot claims, principally the former, which has a shaft of 135′, with some drifting. Surface ores average about $10 per ton; bottom of shaft gives ores assaying up to $80 per ton in gold and copper, from a 6′ vein with 30″ pay streak. Has steam power, with hoist, air compressors, etc.

**NEW MICHIGAN COPPER MINING CO.** **WYOMING.**

Office: Laramie, Wyo. John M. Arthur, superintendent. Supposed to be developing with small force.

**NEW MOUNT HOPE COPPER MINING CO., LTD.** **AUSTRALIA.**

Mine office: Mt. Hope, New South Wales. R. M. Kirk, general manager. Located about 90 miles south of the Great Cobar mine, in the western division of New South Wales. Mine was opened 1878 and production was 131 long tons refined copper in 1898, with total production of 5,070 tons refined copper to that time. Deepest shaft, 400′. Chalcopyrite and bornite occur with a sandstone gangue in a country rock of ferruginous slates and sandstones, at a depth of about 250′, above which ores are oxidized, being mainly earthy carbonates. Ore bodies occur as replacements in the country rock, without defined walls; and have an extreme width of 60′ to 80′. General formation and physical features resemble conditions at the Great Cobar mine. Ore is concentrated about 5 into 1. Mine has smelter with 5 small furnaces, using iron ore secured 12 miles away for a flux.

**NEW RAMBLER MINE.** **WYOMING.**

See Rambler Copper Co.

**NEW RIO TINTO COPPER CO., LTD.** **SPAIN.**

Absorbed by Caridad Copper Co., Ltd.

**NEW RIVER COPPER CO.**

Organized under Delaware laws, August, 1902, with capitalization $1,000,000. No returns secured.

**NEWTON COPPER CO.** **CALIFORNIA.**

Office: 420 Montgomery St., San Francisco. Mine office: Ranlett, Amador Co., Cal. Idle, except for leaching old ore dumps. Organized 1887, under laws of California, with capitalization $200,000, shares $5 par. Horace D. Ranlett, president and general manager. Has 155′ air-shaft and 430′ working shaft, also 4 tunnels and about 2,000′ of drifts and crosscuts. Ore in sight is estimated at 20,000 tons. Has steam plant, using crude petroleum for fuel, and an 80-ton smelter, with modern water-jacket furnace and necessary accessories. Also has a leaching plant for treating low-grade oxide and sulphide ores.

**NEW YELTA COPPER MINING & SMELTING CO., LTD.** **AUSTRALIA.**

Offices: Norfolk House, Lawrence Pountney Hill, London, E. C., Eng. A. C. Arthur, chairman; G. T. Broadbridge, secretary. Capital, nominal, £50,000. Owns the Yelta copper mine at Wallaroo, Daly Co., South Australia. No returns secured.

**NEW YORK GROUP.** **ARIZONA.**

At Williams, Coconino Co., Ariz. T. R. Wells, owner. Property is being opened by a shaft. No returns secured.

**NEW YORK MINE.** **NEVADA.**

Near Lovelock, Humboldt Co., Nev. Letter returned unclaimed, October, 1902, with information by postmaster that property was out of business.

**NEW YORK GOLD & COPPER MINE.** **ARIZONA.**

About 10 miles from Morristown, Ariz. Harry J. Bennett, Phoenix, Ariz., owner. Has one shaft of about 100′, bottomed in a 3′-vein carrying gold and copper, also a 15′ vein carrying 60% to 70% copper. No returns secured.

**NEW YORK & ARIZONA COPPER MINING & SMELTING CO.** **ARIZONA.**

Office: 261 Broadway, New York, N. Y. Mine office: Globe, Gila Co., Ariz. Organized 1901, with capitalization $3,000,000, shares $10 par. Lionel Hagenaers, president; E. G. Maqueston, secretary; T. Shields Collins, superintendent. Lands, 29 claims, area about 600 acres, in Pinal Mountains, about 9 miles from Globe, Ariz., in a district not previously developed. Mine openings are in porphyry, showing chalcopyrite at 50′ to 75′ depth and chalcopyrite with occasional bornite at 200′ depth. No returns secured in response to repeated requests.

**NEW YORK-CANADIAN COPPER SYNDICATE.** **ONTARIO.**

Mine office: Kashaboiwe, Rainy River district, Ontario. Henry Folger, Kingston, Ont., apparently manager; T. R. Jones, superintendent. The old Tip Top mine, near Kashaboiwe, is being reopened by this company with a small force.

**NEW YORK & NEVADA COPPER CO.** **NEVADA.**

Office: 25 Broad St., New York. Mine office: Ely, White Pine Co., Nevada. Organized 1902, under laws of New Jersey, with capitalization $5,000,000, shares $10 par. Mulford Martin, president; Edwin Beach, vice-president; Joshua R. Clair, secretary and treasurer; Walter T. Hook, general manager. Directors are preceding officers, Edw. H. Raynolds and Robert Brown; Jos. Bray, superintendent; S. W. Traylor, consulting engineer. Lands, 28 claims, 7 patented, area 500 acres, also 100-acre millsite and 2,700 acres of miscellaneous lands, in the Robinson district of White Pine Co. Property shows numerous fissure veins, of which 3 are being developed, these having width of 200′ to 300′, length of 2,000′ and depth of 450′, carrying estimated average values of 3.5% copper, traces of silver and $1 gold per ton, from oxide, carbonate and sulphide ores. Has 30 shafts, from 10′ to 450′ deep, with about 6,000′ of underground openings, and 300,000 tons of ore blocked out for stoping. Has steam power, 1 large double-drum hoist and 2 small single-drum hoists. Has 500-ton concentrator, with rolls, impact screen and Bartlett tables. Has smelter at Keystone, 2½ miles from mine, receiving ore by railroad. Smelter has one 56″ U-pipe hot-blast stove and one 42x120″ blast furnace, with Corliss engines, blowers, etc. Product is turned out as matte, averaging 55% copper. Nearest railway, Eureka & Palisade, 70 miles distant. New work contemplated for 1903 includes 6,000′ of underground openings, including 500′ of additional sinking; installation of several new hoisting plants; increase in capacity of concentrator to 1,000 tons, and increase in capacity of smelter to 500 tons. Company estimates probable production in 1903 at 5,000,000 to 7,000,000 lbs., and states that it has every assurance of railroad facilities to its mines and smelters before close of 1903. Six drunken miners called on Mr. Traylor, one evening in December, 1902, and gave him the option of leaving town forthwith or being hanged. Two of the delegation escaped, and four were killed by Mr. Traylor. If clear grit will make this mine a success, Mr. Traylor will bring it through.

**NEW YORK-SEATTLE COPPER MINING CO. WASHINGTON.**

Mine office: Index, Snohomish Co., Wash. C. F. Oliver, president, Hoboken, N. J. Has a 2,000′ tunnel. No returns secured.

**NEW YORK & VIRGINIA COPPER CO. VIRGINIA.**

Office: 149 Broadway, New York. Mine office: Woltz, Carroll Co., Va. Organized 1901, under laws of West Virginia, with capitalization $2,500,000, shares $1 par. Ambrose C. Dunn, president; Richard Berrian vice-president; Wm. D. Boggs, secretary and treasurer. Directors are preceding officers, J. W. Riglander, R. Robert Fogel, and Wm. H. Mitchell. A. C. Dunn, general manager; Jas. Lawson, superintendent. Mining lands, 740 acres in Carroll Co., showing 7 copper bearing fissure veins and 2 gold veins. Two copper veins are being developed, these showing a considerable variety of copper ores, including melaconite, bornite, chalcopyrite, etc., and carrying more or less silver. The largest body ore is said by company to have an average width of 96′ and to be traceable for upwards of two miles. Company's estimate of values is 10% copper, 1 oz. gold and 25 oz. silver per ton. Two shafts were down 100′ and 130′ and 2 tunnels of 100′ each were driving, Nov. 1, 1902. Plant at mine includes steam hoists, pumps, drills, etc. Company plans erecting a concentrator, 300-ton smelter and acid plant in 1903. Nearest railroad station is Betty Baker, on Norfolk & Western R. R., 8 miles distant. Mining work planned for 1903 consists of sinking two shafts to depth of 400′ each, drifting, crosscutting and stoping. Company states that up to November 1, 1902, more than 40,000 tons of ore had been extracted, of an estimated value of upwards of $1,500,000.

**NEWS COPPER MINING CO. ARIZONA.**

Property supposed to be located in Arizona and presumably in hands of Chas. R. Leonard of Butte, Mont. No returns secured.

**NEWSBOY COPPER MINING CO. WYOMING.**

Supposed to have property near Encampment, Carbon Co., Wyo. No returns secured.

**NIAGARA MINING & DEVELOPMENT CO. BRITISH COLUMBIA.**

It is said that a corporation by this name, in which Geo. J. Gould, of New York is alleged to be interested, is doing work on the Skeena river, in Kitsalas Canyon, in the extreme northern part of British Columbia, near the Alaskan line. Company is supposed to have a capitalization of $600,000, in $5 shares. S. Arden Singlehurst is in charge of operations. No address secured for main office or mine postoffice.

**NIAGARA MINING & SMELTING CO. UTAH.**

Has an apparently valuable property near Bingham Canyon, Salt Lake Co., Utah, but was in financial straits at last accounts. No returns secured.

**NICHOLS CHEMICAL CO. QUEBEC.**

Office: 25 Broad St., New York. Is operating mines at Capelton, Quebec, with force of about 100 men. W. H. Nichols, president; J. B. F. Herreshoff, vice-president; J. M. Luther, secretary; E. R. Nichols, treasurer; S. L. Spofford, general manager at mines. Lands, 640 acres, carrying lenses of chalcopyrite and iron pyrites, former with an average value of 5% copper and 38% sulphur. Property has 6 shafts, one down 2,000′, one 800′ and 4 less than 500′. Mines have about 5 miles of underground openings, with steam power equipment throughout and 150-ton concentrator and smelter. Product is turned out as 50% matte. This company is supposed also to be operating near Tampico, Tamaulipas, Mexico, but no returns have been secured for the Mexican properties.

**NICKEL COPPER CO. ONTARIO.**

Offices: Worthington, Ontario. Mining property is in Drury Twp., near Sudbury, Algoma, Ont. Ore is sent to Hamilton, Ont., for smelting. Property thought to be valuable. Company said to have been very poorly managed.

**NICKEL PLATE MINE. BRITISH COLUMBIA.**

Near Olalla, B. C. Owned by Rogers Bros., et al. Said to be rich and to have a large amount of ore on the dumps. No returns secured.

**NIGHT HAWK MINING CO. WASHINGTON.**

Office: 201 Uihlein Bldg., Milwaukee, Wis. Employs 14 men. Organized 1901, under laws of Washington, with capitalization $5,000,000, shares $1 par. A. M. Wehe, president and general manager; P. J. Somers, vice-president; H. D. James, secretary and treasurer; A. Geo. Wehe, superintendent. Lands, 65 claims, area 1,350 acres, with 150 acres miscellaneous lands, including townsite and millsite, on Mt. Ellemeham, in the Wannacut Lake district of Okanogan Co., Wash., showing numerous fissure veins, of which 5 are being developed, these averaging 6′ to 10′ in width, with estimated length of one mile and estimated average values of 8% copper and 1 oz. gold per ton. Mine has shafts of 40′ and 130′ and tunnels of 40′ and 126′. Nearest railroad is 68 miles, but line is to be built to the mines in 1903.

**NIPPER CONSOLIDATED COPPER CO. MONTANA.**

Office: 31 Nassau St., New York. Mine office: Butte, Silver Bow Co., Mont. Employs about 250 men. Capitalization $3,750,000. Bonded debt, $2,500,000. Geo. H. Robinson, president; John MacGinnis, vice-president; Stanley Gifford, secretary and treasurer. Annual meeting, May 1. Property is controlled by the United Copper Co. Mine is located at Butte, Silver Bow Co., Mont., with 2 shafts, down about 1,000′ each. Mine is well equipped with machinery and timbered with 10x10″ square sets, having 12 exits and good ventilation. Connected underground with the Parrot, Never Sweat and Little Minah mines.

**NOGALES COPPER CO. ARIZONA & MEXICO.**

Office: 100 State St., Chicago, Ill. Mine office: Nogales, Santa Cruz Co., Ariz. Employs 100 men. Organized 1902, under laws of Arizona, with capitalization $3,000,000, shares $5 par. Dr. Arthur E. Thomas, president; Wm. Larsen, vice-president; Dr. Wesley M. Thomas, secretary; Geo. S. Brigham, treasurer. Directors are preceding officers, Edmund D. Brigham and Dr. John Wix Thomas. Colby N. Thomas, general manager; Frank N. Cox, superintendent; H. B. Sturtevant, consulting engineer. Lands, 27 unpatented claims, area 540 acres, also 10-acre millsite, in the Patagonia and Pajorita districts of Santa Cruz Co., Arizona, and the Minas Prietas district of Sonora, Mexico. Claims show 7 fissure veins, of which 3 are being developed, these averaging 4′ to 5′ in width and 1,200′ to 6,000′ in length, giving average assays of 5% to 8% copper and 2 to 15 oz. silver per ton, 20 to 65 oz. silver per ton being found in the Pena Blanca claims. Ores are oxide and sulphide.

The Buena Vista group in the Patagonia district has 15 mineral claims, 2 timber claims, millsite and water rights. The Pena Blanca group in the Pajorita district, 12 miles west of Nogales, has 6 claims; the San Bartolo group, in the Minas Prietas district, is near Hermosillo, Sonora. Adequate water supply can be secured, at each of these groups, by pumping. Smelting conditions are excellent, as the ores are capped by gossan and occur in limestone. Mines will be opened by tunnels. This company, which is composed of men of high standing, is but fairly beginning operations at the close of 1902. The property gives promise of developing good mines.

**NOME-MONTANA-NEW MEXICO CO.**

Office: 415 Iron Block, Milwaukee, Wis. Jas. M. Kerr, president. Claims in advertisement to have gold property at Nome, Alaska, and copper claims in Montana and New Mexico. Montana claims said to adjoin the Copper Cliff mine. Said to have 60 acres in the Bromide district of Rio Arriba Co., N. M. Advertisements are very comprehensive in their claims, but no detailed returns have been furnished for this work in response to repeated requests.

**NONESUCH MINE.** **MICHIGAN.**

Owned by A. K. Camp and M. P. O'Brien, of Milwaukee, Wis. This property is the pioneer and principal mine in the Porcupine Mountain district of Ontonagon county, Michigan. Area, 640 acres. Total production, 182 tons, 1,072 pounds refined copper. Idle for many years. Mine carries native copper freely in an argillaceous conglomerate-sandstone. Fully described in 1902 edition.

**NORMANBY SYNDICATE.** **AUSTRALIA.**

Mine office: Mt. Perry, Tenningering district, Queensland, Australia. Lands, 240 acres freehold. Employs 35 men. Lode is parallel to that of the Mt. Perry mine, with similar geological features. Has been opened to a depth of about 200′. Ores carry 1 to 10 oz. gold per ton. Property well located for mining and smelting, and apparently is of considerable promise.

**NORSK-BELGISK MINEKOMPANI.** **NORWAY.**

Mine office: Melhus, Flaa sogn, Norway. Is in the Röros district, and was working a fahlband, in a small way, at last accounts.

**NORTH AMERICAN COPPER CO.** **WYOMING.**

Office: 17th and Blake Sts., Denver, Colo. Mine office: Rudefeha, Carbon Co., Wyo. Organized 1902, under laws of New Jersey, with capitalization $20,000,000, shares $100 par. John S. Cary, president; Willis Geo. Emerson, first vice-president; C. P. Collins, second vice-president; C. E. Knapp, secretary; J. H. Fennessy, treasurer. Directors are preceding officers, J. R.

Leonard, John J. Carter, Kenneth K. McLaren and Jos. Seep. W. H. Bunce, general superintendent; Arthur Houle, mill and smelter superintendent. Lands, 5 claims, area 103 acres, including the well-known Ferris-Haggerty mine, in the Battle Lake district of Carbon Co., Wyoming. This mine has the most extensive underground development of any property in the Wyoming copper fields, and is installing a large concentrating and smelting plant. The concentrator is to have 500 tons daily capacity, and will be equipped with crushers, rolls, jigs and 36 Wilfley tables. The smelter is at Encampment, Wyo., 16 miles from the mine, being connected therewith by an aerial tramway 16 miles in length. This is much the longest installation of the sort ever made, the tramway being built in 4 sections of 4 miles each. In addition to transporting the ore of this company, the tramway carries ore to the smelter from a number of other properties along the line.

The smelter has a complete sampling mill, roasters, furnaces and briquetting plant. Product has been turned out as matte heretofore, but company is now installing a converter plant which should be in operation by April, 1903, and will give the smelter capacity to handle 600 to 700 tons of ore daily. It is hoped by the company that the converter plant will enable the mine and smelter to turn out about 30 tons of blister copper daily, which would give the mine a productive capacity at the rate of 18,000,000 pounds per year, when the smelter goes into full commission. The property of this company is undoubtedly a valuable one, and the cost of producing copper will be materially lessened by the saving of considerable gold and silver values carried in the ore.

**NORTH AMERICAN EXPLORATION CO. ARIZONA.**

Mine office: Gilbert, Yavapai Co., Ariz. Geo. W. Middleton, superintendent. Has gold-copper ores and is equipped with gasoline hoists. No returns secured.

**NORTH AMERICAN MINING CO. IDAHO.**

Office: Des Moines, Iowa. Mine office: Baker City, Ore. Organized 1898, with capitalization $1,500,000, shares $1 par. Thos. Burk, president and manager; S. S. Cole, secretary and treasurer. Lands, 807 acres mineral claims and 1,000 acres miscellaneous lands, in the Burkmont district of Idaho. At last accounts had 3 shafts, deepest 300′, giving assays of 6% to 8% copper, with gold and silver values. Company estimated ore body as 300′ wide and one mile in length. No returns secured for 1902.

**NORTH AMERICAN MINING CO. NEW MEXICO.**

Office: Shamokin, Pa. Mine office: Lordsburg, Grant Co., N. M. Employs 6 men. Organized under laws of New Mexico, with capitalization $1,200,000, shares $2 par. Thos. A. Lister, president, treasurer and general manager; G. G. Kulp, vice-president; W. P. Caldwell, secretary; Danl. W. Briel, superintendent. Lands, 7 unpatented claims, showing fissure veins giving average assays of 18% copper, $10 gold and 15 oz. silver per ton. Has four 10′ pits and shafts of 37′ and 50′. The incline shaft of the Cobre Negro claim is 115′ deep. This slope will be continued for 1,000′ and levels run at intervals of 100′. Nearest railroad, 4 miles. The Cobre Negro shows 4 promising fissure veins, the principal one carrying a rich pay-streak of 18" to 36" on the footwall, containing copper, gold and silver in a quartz gangue, while on the hanging wall there is a pay-streak of tetrahedrite, showing 13% copper and 15 oz. silver per ton, with very high gold values.

**NORTH AMERICAN MINING CO. OREGON.**

Said to be prospecting for copper near Union, Union Co., Ore.

**NORTH CAROLINA MINE. NORTH CAROLINA.**

Formerly known as the Fentress. Was extensively worked before the Civil war. Has a 3′ to 4′ vein, dipping at 38° to 60°, and opened to depth of 310′. Supposed to be working, but no direct returns, secured.

**NORTH FORK COPPER MINING CO. WYOMING.**

Mine office: Battle, Carbon Co., Wyo. Stuart Edgar, superintendent. Supposed to be working a small force at the close of 1902.

**NORTH MOUNT LYELL COPPER CO., LTD. TASMANIA.**

Offices: 153–5, Leadenhall St., London, E. C., Eng. Colonial office: Pillinger, Macquarie Harbour, Tasmania. Employed 715 men in October, 1902. W. Jacks, chairman; H. Macdonald, deputy chairman; F. D. Mitchell and J. P. Madden, colonial board; Genl. Sir Hugh Gough, trustee for debenture holders; L. C. Trent, general manager; T. Urquhart, secretary; F. D. Mitchell, agent, Kelly's Basin, Tasmania. Capital, nominal, £600,000; debentures, £160,000. Mining lands, 30 acres, also concentrator and smelter sites, water rights, timber lands and railway of 28 miles from mines to smelter. Output, first half of 1902, about 24,000 tons of copper ore; is anticipated that present management will be more fortunate than former director. Ore contains 6% to 12% copper, 15% to 20% alumina, and 60% to 75% silica, requiring a basic ore for fluxing, such as is furnished by the Mt. Lyell mine. Has a 250-ton smelter, with converter plant added in 1902. Smelter is 75x210′, with electric crane, and has 4 reverberatory furnaces, each 16x32′, blast furnace and converters; sampling mill 69x72′; boiler house 41x56′ with three 250-h. p. Stirling boilers; power station 60x100′ with 200-kilowatt generators and cross compound blower; concentrator 50x284′, and miscellaneous buildings. This property is a valuable one but it could be consolidated with the mines of the Mt. Lyell Mining & Railway Co. to the great and lasting advantage of both corporations, owing to the ores of each being natural complements.

**NORTH PACIFIC MINE. MONTANA.**

Mine office: Copperopolis, Meagher Co., Mont. Owned by the Marcus Daly estate of Butte, Mont., and operated by W. W. McDowell. John Blewett, superintendent. Property includes the St. John mine and employs about 100 men. Has 3 shafts, deepest 500′, with good surface equipment. Property has been a limited producer of high grade ore for some years. Said to be looking rather poorly at close of 1902.

**NORTH POLE MINING CO. COLORADO.**

Mine office: Crystal, Gunnison Co., Colo. Organized 1902, with capitalization $500,000. Property is developed by 200′ tunnel, showing 15% to 20%

copper ore, slightly argentiferous. Company was erecting buildings and installing machinery for development at last accounts.

**NORTH STAR MINING CO.** **WASHINGTON.**

Mine office: Index, Snohomish Co., Wash. S. A. Davis, superintendent. Lands, 7 claims between the Ethel and Bunker Hill-Sullivan properties. Has 2 veins, one 3′ to 6′ wide, with 4″ pay-streak assaying $135 per ton in copper and gold. Ore is argentiferous tetrahedrite and bornite.

**NORTH STAR MINING & MILLING CO.** **COLORADO.**

Mine office: Silverton, San Juan Co., Colo. J. H. Starkweather, superintendent. Mine has gold-silver-copper ores and is equipped with steam and water power and a 60-stamp mill.

**NORTH STAR MINE.** **NORTH CAROLINA.**

An old property near Jamestown, Guilford Co., N. C. Vein runs 2′ to 25′ wide, giving auriferous iron-copper sulphides. Mine is about 400′ deep and has a 20-stamp mill.

**NORTHWEST COPPER CO.** **BRITISH COLUMBIA.**

Took the Van Anda mines under bond and lease, in October, 1901, but threw them up a few months later.

**NORTHWEST GOLD & COPPER CO.** **OREGON.**

Property is in the Cracker Creek district of Sumpter, Ore., and is said to show a 60′ vein on the Colorado claim.

**NORTHWEST MINING CO.** **WASHINGTON.**

Mine office: Kettle Falls, Stevens Co., Wash. W. F. Stevens, superintendent. Has gold-silver-lead-copper ores; opened by shaft and tunnel. Mine is equipped with steam and water power and employs about 40 men.

**NORTHWESTERN CONSOLIDATED LUMBER, OIL & COPPER CO.** **OREGON.**

Address: care of Glenn M. Deuel, secretary, Grand Rapids, Mich. Dr. O. A. Lacrone, president and general manager, Kalamazoo, Mich.; Geo. Bardeen, vice-president; W. R. Beebe, treasurer, Directors are preceding officers, E. C. Dayton, John H. Price, Samuel Dunkley, Rush McNair and Thos. Mars. Lands are somewhere in the vicinity of Baker City, Oregon.

**NORTHWESTERN COPPER MINING CO.** **WYOMING.**

Address: care of F. E. Brown, agent, Omaha, Neb. Lands are in Wyoming. No returns secured, but company thought to be working a small force at close of 1902.

**NORTHERN COPPER CO., LTD.** **RHODESIA.**

Offices: Salisbury House, London, E. C., Eng. Local office: Bulawayo, Rhodesia, B. S. A. Lord Gifford, chairman; T. Donald, secretary; Bechuanaland Exploration Co., Ltd., manager in South Africa. Capital, nominal, £250,000. Property, 220 claims in Umniati, Umsweswe and Guay districts, near the Kafukwe river, in Northern Rhodesia. Prospecting and development work have been continued for the past two years, and ancient mine workings are reported in the neighborhood, of which the oxide ores show very high values, ranging from 20% to 71% copper. The grade of the sulphide ores that will come in at depth remains to be ascertained.

**NORTHERN CALIFORNIA INVESTMENT CO.** **CALIFORNIA.**

Owns the Black Diamond group, in the Stillwater mining district of Shasta Co., Cal. Geo. Bayha, vice-president and general manager. Has large holdings, on which several low-grade ore bodies of considerable size have been located.

**NORVELL-PICKRELL COPPER MINING CO.** **WYOMING.**

Mine office: Encampment, Carbon Co., Wyo. J. S. Norvell, superintendent. Was employing a few men on development work at last accounts.

**NORWAY GROUP.** **WASHINGTON.**

A group of 9 claims showing a 25′ vein opened by tunnel, in the neighborhood of the Bronze Monarch group, Washington.

**NORWAY MOUNTAIN GOLD & COPPER MINING CO.** **BRITISH COLUMBIA.**

Address: care of Thomas & Co., fiscal agents, 503 Provident Bldg., Philadelphia, Pa. Property supposed to be near Rossland, B. C. No returns secured.

**NORWEGIAN COPPER MINES, LTD.** **NORWAY.**

Offices: 5, St. Mildred's Court, London, E. C., Eng. H. W. Lowe, chairman; H. P. Smith, secretary. Capital, nominal, £300,000. Owns the Lyngen group, in the Goulasjok Valley, Lyngenfjord district, Norway. No returns secured.

**NORWICH MINE.** **MICHIGAN.**

Address: care of Neil J. Ferguson, superintendent, Ontonagon, Mich. Property some distance west of the Ontonagon river, Ontonagon Co., Mich. Made 500 tons of copper 1850–1851; last work done 1865. Has produced masses of copper up to 10 tons weight, and gives a fair showing of stamp rock. Said to have been bought, December, 1902, by the Copper Crown Mining Co., of St. Louis, but statement not verified.

**NOTAWAY GOLD & COPPER MINING CO.** **COLORADO.**

Office: Denver, Colo. Mine office; Silverton, San Juan Co., Col. A. J. Vivian, president and general manager; Wm. Gelder, secretary; N. B. Gamble, superintendent. Lands, two group of claims, one in Gilpin Co. and one in San Juan Co., Colorado. Latter is on Sultan Mountain, near Silverton, and has been developed since about 1897, by 400′ tunnel. Has electric power and employs 15 to 20 men.

**NOVARRA.** **ITALY.**

A small mine in the province of Piedemont, Italy. No returns secured.

**COMPANIA LOS NUEVE.** **SPAIN.**

Offices: San Andres, 26, Madrid, Spain. Mines are in province of Almeria, Spain. No returns secured, and mines thought to be idle.

**NYACK MINING CO.** **ARIZONA.**

Mine office: Williams, Cononino Co., Ariz. J. Helmle, superintendent. No returns secured.

**NYMAGEE COPPER MINING SYNDICATE.** **AUSTRALIA.**

Address: Lithgow, New South Wales. Property is about 50 miles from the Great Cobar, without railway facilities. Has 3 shafts, deepest 734′, in a disseminated sulphide ore traversing arcenaceous slates, ore running about 2% copper, with narrow chutes of high grade sulphides averaging about 9% copper in the stopes worked. Has a smelter, using the pyritic process and water-jacket blast furnaces.

**OAK HILL COPPER MINE. CALIFORNIA.**

At Cooperstown, Tuolumne Co., Cal. Owned by Henry Willey, et al. Has one shaft 112′ deep, with a little drifting. No returns secured.

**OAK HILL MINE. NORTH CAROLINA.**

In the neighborhood of High Point, N. C. Said to have a 7′ vein carrying bornite, covellite and chalcopyrite, averaging 18% copper. No returns secured.

**OCTAVIA MINING CO. WYOMING.**

Mine office: Cambria, Wyo. David Jones, president. Supposed to have secured a considerable amount of development work. Was employing a small force at last accounts.

**OGOYA MINE. JAPAN.**

In the province of Kaga, Japan. Opened about 1880; makes about 600 tons refined copper yearly. Methods and plant partly modernized. No returns secured.

**OHIO & ARIZONA COPPER MINING & SMELTING CO.**

Secretary writes that company will be dissolved.

**O. K. EXTENSION MINING & REDUCTION CO. UTAH.**

Office: 40 Commercial Blk., Salt Lake City, Utah. Mine office: Frisco, Beaver Co., Utah. Employs 6 men. Organized 1899, under laws of Utah, with capitalization $150,000, shares 50 cents par. A. J. McMullen, president and general manager; T. M. Farrell, vice-president; C. E. Gott, secretary and treasurer; Robert Leroy, superintendent. Directors are preceding officers, C. S. Smith and E. A. Cook. Lands, 23 claims, 2 patented, area 360 acres, in the Beaver Lake district of Beaver Co., having 2 fissure veins with average width 30′ and estimated length 3,000′, showing a large body of low-grade sulphide ore, estimated to average 3% copper. A new shaft on an adjoining claim gives assays of 16%. Has shafts of 60′, 80′, 95′, 110′ and 510′ and tunnels of 20′ and 160′, with 1,100′ of underground openings. Steam power. Mine will ship ore to the new furnace at Milford, 8 miles distant. Oregon short Line Ry. is two miles from the mine. Company will continue underground development and install larger boiler and hoist in 1903.

**OLALLA COPPER MINING & SMELTING CO. BRITISH COLUMBIA.**

Address: care of Albert E. Hall, Co., 5 Beekman St., New York. Mine office: Olalla, Similkameen district, B. C. Organized 1901, under laws of Maine, with capitalization $8,000,000, shares $25 par. M. J. Brewer, president; Robert Gay, vice-president; W. C. McDougall, general manager. Lands, 60 claims, area 2,500 acres, near Olalla, in the Lower Similkameen and Keremos camps, Yale district, southern British Columbia. Company also controls the Similkameen and Keremos Ry. Co., capitalized at $3,000,000. Is said to have valuable mining prospects and company is composed of men of excellent standing, but no returns have been furnished for this work in response to repeated requests.

**OLD BALDY MINE.** **ARIZONA.**

Near Tucson, Pima Co., Ariz. W. B. McCleary, superintendent. Has gold-copper ores, opened by shaft. Steam power.

**OLD BALDY GOLD MINING & TUNNEL CO.** **NEW MEXICO.**

Mine office: Elizabethtown, Colfax Co., N. M. Thos. C. Sewall, superintendent. Is opening gold-copper ores by tunnel. Has gasoline hoists and electric power.

**OLD COLONY COPPER CO.** **MICHIGAN.**

Office: 60 State St., Boston, Mass. Mine office: Calumet, Houghton Co., Mich. Is an exploration, working 12 to 15 men. Organized 1898, under laws of Michigan, with capitalization $2,500,000, in 100,000 shares, par $25, and $10 paid in. H. F. Fay, president; W. B. Mosman, secretary and treasurer; H. F. Fay, W. B. Mosman, John C. Watson, Stephen R. Dow, Rogers L. Barstow, Wm. Howell Reed, Jas. Chynoweth, directors; Jas. Chynoweth, superintendent.

Official sworn returns to the State of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $300,000.00 |
| Amount paid in by conveyance of property to company | 700,000.00 |
| Entire amount invested in real estate | 750,000.00 |
| Amount of personal estate | 66,682.97 |

No floating debt, nothing due corporation and no production secured.

The old Colony lands are 1,200 acres in Sections 17 and 18, 56-32, east of the Calumet & Hecla, Houghton Co., Michigan. The surface may eventually become valuable for building lots, as it adjoins the village of Laurium, which is part of the great mining camp of Calumet. The tract has been tested by diamond drills for 1,500′ on the west, and by a tunnel 3,000′ long, begun in 1899 and discontinued late in 1901, which begins at the Eastern sandstone and runs 33° North of West. Five cupriferous beds were cut by the tunnel, none of which showed copper to an especially promising extent. There are several shafts, all unimportant except the westernmost, which lies about 1,500′ east of the Kearsarge shafts of the Centennial. This shaft penetrates an 80′ overburden. One level is opened by short drifts and a winze is sinking on the first level, following the incline of the lode, only 50′ from the shaft. This winze can be holed through to surface at the angle of the lode and made a permanent working shaft, if the developments warrant. Depth at end of 1902 is more than 200′. The lode shows copper to some extent—not enough to make a mine, but sufficiently encouraging to warrant opening to a greater extent. The Old Colony has necessary surface buildings, all small, with boilers, smithy, tools, etc., and is operating one power drill in the winze. Funds will be exhausted soon, and an assessment of one dollar is anticipated early in 1903.

**OLD DOMINION COPPER MINING & SMELTING CO.** **ARIZONA.**

Office: 35 Congress St., Boston, Mass. Mine office: Globe, Gila Co., Ariz. Employs about 300 men. Organized July, 1895, under laws of New Jersey, with capitalization $5,000,000, shares $25 par. Chas. Sumner Smith, president; Fred M. Hoar, superintendent. Directors are Chas. S. Smith, Geo. Napier Towle, Dr. Jos. T. Herrick, Chas. T. Lund, Fred M. Hoar, E. F. Newton and G. Waldo Smith, the first three directors named constituting an executive committee.

Lands, 6 full and 3 fractional claims, at Globe, Gila Co., with 10-acre millsite adjoining, also, the Old Dominion and Keystone claims, north of Globe, the Continental group of 240 acres and the Chicago & New York group of 60 acres, the two latter groups being unconnected with the principal mining tract. Ore bodies are either fissure veins or lenses, but which, is uncertain. Ores are mainly malachite, with some melaconite and cuprite and a little chrysocolla, all more or less argentiferous and highly silicious, requiring heavy fluxes of iron and lime. Sulphide ore bodies, showing chalcopyrite and considerable chalcocite, are found in narrow but rich veins. Company is endeavoring to open additional bodies of sulphide ore, to obviate the necessity of using large quantities of barren flux.

The deepest working is the 12th level, opened in 1902. Much trouble has been experienced in the past from excessive freight rates, the mine having been paying freights of upwards of $300,000 yearly to the Gila Valley, Globe & Northern railway line, running 125 miles from Globe to Bowie. Reduced rates were secured in October, 1902, and the saving in freights is estimated at 1 to 1½ cents per pound, on the present production of about 800,000 pounds per month. Output for 1901 was 10,094,787 lbs. refined copper, costing 12¼ cents per lb. laid down at the seaboard. For the quarter ending June 30, 1902, costs were estimated at 11¼ cents per lb., and at the close of the year were probably in the neighborhood of 10 cents per lb. Costs for 1901 were $5.87 per ton for mining and $4.87 per ton for smelting. Economies have been introduced wherever possible by the present management.

The smelter at the mine has three 250-ton furnaces, and is beyond the present capacity of the mine to feed. A briquetting plant for flue dust and a reverberatory slag furnace were installed in 1902, since which time slags are said to be running only 0.75% copper. Experiments have been made with petroleum for fuel, coke being very costly.

The value of company's production of gold, silver and copper to close of 1900 was $3,567,577.83, which was produced at a mining profit of $852,961.16, against which were expenditures of $841,217.64 for construction, leaving a net profit of $11,743.52. Several small dividends were paid by the original Old Dominion company, but none have been disbursed by the present corporation. The management of the mine was changed in 1902, and the present officials have brought suit against A. S. Bigelow and the estate of Leonard Lewisohn for the proceeds from 50,000 shares of stock, said to have been illegally converted to the uses of the defendants.

The Old Dominion's ore bodies are considerably mixed and require careful hand-sorting, both underground and on surface. It is evident that the mine is not the bonanza that has been claimed in many quarters. The present management is making vigorous and successful efforts to reduce costs and to improve the plant and facilities.

**OLD HANOVER COPPER CO.** **NEW MEXICO.**

Mine office: Hanover, Donna Ana Co., N. M. Geo. Kingdon, superintendent. Said to be equipped with steam power and to work a considerable force.

**OLD HICKORY COPPER MINING CO.** **NEW MEXICO.**

Absorbed by the Copper Chief.

**OLD RELIABLE MINING CO.** **NEW MEXICO.**

Mine office: Golden, Santa Fe Co., N. M. J. B. Mayo, superintendent. Is opening gold-copper ores by tunnel. Has steam power equipment, including two 5′ Huntington mills. No direct returns secured.

**MINAS DE OLLIN, CHANGOA Y ARRIETA.** **SPAIN.**

Old properties in the province of Navarra, Spain. Supposed to be owned by an English corporation, but no particulars learned.

**OLYMPIA MINING CO. OF WYOMING.** **WYOMING.**

Office: 187 E. Chicago Ave., Chicago, Ills. Pehr W. Nilsson, president; Herman C. Johnson, secretary; John Lundgren, general manager. Property is supposed to be in the Encampment district of Carbon Co., Wyo. No returns secured.

**OLYMPIC MINING CO.** **WASHINGTON.**

Office: Pacific Bldg., Seattle, Wash. Company advertises nicely, but fails to give particulars regarding its property, for this work.

**OMAHA COPPER MINING CO.**

Office: 1,017 New York Life Bldg., Omaha, Neb. No returns secured.

**OMODANI MINE.** **JAPAN.**

A very old property, in the province of Echigo, Japan. Makes about 400 tons of exceptionally pure copper, yearly.

**ONECO COPPER MINING CO.** **MICHIGAN.**

Office: 18 P. O. Sq., Boston, Mass. W. F. Fitzgerald, president; S. S. Millett, secretary and treasurer. Organized 1899, under laws of Michigan, with capitalization $2,500,000, shares $25 par. Lands, 800 acres, near Hancock, Houghton Co., Mich. Tract was originally known as the Hungarian, later as the Fitzgerald. Has had a limited amount of exploratory work in 1862 and 1899–1900. Has one shaft of about 500′, also 8 dwellings and several small mine buildings. Fully described in 1902 edition.

**ONTARIO SMELTING CO.** **ONTARIO.**

Mine is three miles from Massey Station, Algoma, Ontario, and shows auriferous sulphides assaying 3½% to 6% copper.

**ONTARIO & COLORADO GOLD & COPPER MINING CO.** **COLORADO, ONTARIO & YUKON.**

Office: 610 Majestic Bldg., Detroit, Mich. Dr. J. E. Burgess, president; C. H. Colburn, secretary. Has mining claims in Ontario, Yukon and Colorado. The Ontario claims adjoin the Wilcox property, on Spider Lake, in the Parry Sound district. No returns secured.

**OOKIEP MINE. CAPE COLONY.**

Owned and operated by the Cape Copper Co., which see, for description.

**OPHIR CONSOLIDATED MINING CO. COLORADO.**

Mine office: Telluride, San Miguel Co., Colo. W. S. Buckley, manager; Jas. MacWilliams, superintendent. Has a 20-stamp mill, with steam and electric power, and employs about 50 men, securing a little copper as a by-product from gold-silver-lead-copper ores.

**OPHIR COPPER MINING CO. MONTANA.**

Office and mine: Butte, Silver Bow Co., Mont. Organized July, 1902, under laws of South Dakota, with capitalization $1,000,000, by Chas. Caldwell, C. H. Carmack, Maurice Newberger, E. Tilden and Frank H. Penney of Chicago, and A. B. Clark and Henry S. Clark of Butte, Mont. Company is developing the Ophir mine, in Butte, which shows 3 veins carrying fair values in silver and gold, with indications that copper will be found at greater depth.

**OPHIR MINING & DEVELOPING CO. MONTANA.**

Office: 902 Fisher Bldg., Chicago, Ills. Probably same as Ophir Copper Mining Co. No returns secured.

**OQUIRRH-BINGHAM COPPER CO. WYOMING & UTAH.**

Office: 1103–279 Dearborn St., Chicago, Ill. Organized under laws of Wyoming, with capitalization $1,000,000. Properties supposed to be in Wyoming and Utah, mainly the former. No returns secured.

**ORDENAURA MINING CO. MEXICO.**

Mine office: Valardena, Durango, Mexico. E. K. McCann, manager. Has copper, silver and lead ores. Employed a small force at last accounts.

**ORE KNOB MINE. NORTH CAROLINA.**

Located near New River, Ashe Co., N. C. Was opened before the Civil War and closed 1885. Is said to have yielded net profits of $60,302 in 1874. Has a fissure vein of 6′ to 20′ width, with nearly vertical dip, carrying mainly sulphide ores, and crossing a formation of micaceous gneiss and mica schist. Vein said to be nearly free from gangue and to average 12% to 20% copper. Has 11 shafts, deepest 400′. Was equipped with a new 150-ton smelter in 1902.

**OREGON GOLD & COPPER CO. OREGON.**

Incorporated August, 1902, by Anthony Mohr, et al., of Sumpter, Ore. No returns secured.

**OREGON SHORT LINE MINING CO. NEVADA.**

Mine office: Pioche, Lincoln Co., Nev. E. F. Freudenthal, superintendent. Was developing copper, silver and lead ores, with small force, at last accounts.

**ORIENT GOLD MINING CO. WASHINGTON.**

Mine office: Bossburg, Stevens Co., Wash. John Brown, superintendent. Has gold-copper ores and steam plant. Employed a small force at last accounts.

**ORIENTE DE THARSIS GROUP. SPAIN.**

Address: care of Wm. Guthrie Bowie, manager, Alosno, Huelva, Spain. Property is a large group of government concessions, including the Huera, showing extensive outcrops, remains of ancient works and some old scoria. Has about 400 metres of underground development on a 5% copper ore body of 12½ metres, a 4% ore body of 7 metres and a 3.5% ore body of 5 metres, while a mass of cupriferous pyrites has also been cut to the northward. Deepest crosscut, about 90 metres below the crest of the hill, is on a level with the Tharsis railway, and ore can be shoveled into the cars.

**ORINOCO MINE. BRITISH COLUMBIA.**

At Beasley, 7 miles west of Nelson, B. C. Letter returned unclaimed, October, 1902.

**ORION MINING CO. NEW MEXICO.**

Mine office: Lordsburg, Grant Co., N. M. B. W. Randall, superintendent. Has ores carrying copper, gold and silver; opened by shaft and tunnel. Has gasoline hoists, etc. No returns secured.

**SOCIEDAD MINERA EL ORITO. CHILE.**

Mine office: El Orito, San Felix Vallenar, Chile. Operates Las Breas mines, opened 1888, and makes about 700 tons of copper yearly, shipped as matte. Also owns the Carmen mine, 190′ deep, opened in 1857, which was idle at last accounts.

**ORO GRANDE MINE. ARIZONA.**

Near Wickenburg, Maricopa Co., Ariz. Has upwards of 3,500′ of underground openings, showing an ore body more than 100′ wide carrying high-grade oxides and low-grade sulphides, somewhat mixed with country rock.

**FRANCISCO RODRIGUEZ OROZZO. MEXICO.**

Name given by Mexican government as operator of a copper mine at Mazapil, Zacatecas, Mexico. No returns secured.

**ORTONA COPPER MINE. AUSTRALIA.**

At Percyville, Queensland, Australia. A. Linedale, Irvinebank, Queensland, owner. Is opened by a shallow shaft. No returns secured.

**ORVILLE GOLD & COPPER MINING CO. BRITISH COLUMBIA.**

A prospect near Golden, Yale & Cariboo district, B. C. M. Damaid, superintendent, at last accounts.

**OSARUSAWA MINE. JAPAN.**

In the province of Rikuchu, Japan. Ores, mainly chalcopyrite and galena, with auriferous quartz walls. Produces copper, gold, silver and lead. Has a partly modern equipment and makes about 1,000 tons of refined copper yearly.

**OSCEOLA CONSOLIDATED MINING CO. MICHIGAN.**

Office: 199 Washington St., Boston, Mass. Mine office: Opechee, Houghton Co., Mich. Organized 1873, under laws of Michigan; capitalization increased to $2,500,000, with 100,000 shares, par $25, in 1897, when the Kearsarge and Tamarack Junior companies were absorbed. Annual meeting, second Thursday in March. A. S. Bigelow, president; W. J. Ladd, secretary and treasurer; directors are A. S. Bigelow, W. J. Ladd, J. Henry Brooks, Edw. S. Grew and Jos. S. Bigelow. Wm. E. Parnall, Jr., acting superintendent; Wm. C. Watson, assistant superintendent. A. L. Burgan, mill superintendent, Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $ 480,000.00 |
| Amount paid in by conveyance of property to company | 1,923,750.00 |
| Entire amount invested in real estate | 1,301,221.47 |
| Amount of personal estate | 1,425,715.73 |
| Amount of unsecured or floating debt | 1,667,213.88 |
| Production of copper, 1901, in pounds | 13,723,487 |

The Osceola company first worked the Calumet conglomerate, just south of the Calumet & Hecla, sinking 6 shafts thereon, but this proving unremunerative the Osceola amygdaloid was opened. The company owns four entirely distinct and unconnected mines, these being the Osceola proper, Tamarack Junior, North Kearsarge and South Kearsarge. The two latter are much the most valuable.

The Osceola proper has 720 acres, lying next south of the Calumet & Hecla. It has 6 abandoned shafts on the conglomerate and 6 shafts on the Osceola amygdaloid, which has a strike of approximately N. 39° E. Shafts 1 and 2, the northernmost, are permanently abandoned. No. 3 has 3 compartments and is about 3,000′ deep. No. 4, 600′ south, has 3 compartments and is about 3,700′ deep. Shafts 3 and 4, which were producing about 600 tons of rock daily, were closed June, 1902. They are not worked out, but could not be operated profitably on a 12-cent copper market. No. 5 is 1,300′ south of No. 3 and is about 3,600′ deep. This shaft was badly damaged by a crush extending for a long distance, and repairs, begun in the spring of 1902, will be completed early in 1903. The trouble came from insufficient pillars. No. 6, or "Opechee" shaft is 1,300′ next south, 4,000′ deep and at present is the only really good shaft of the Osceola proper. It is showing some excellent stopes, especially in the southern drifts. Shafts 5 and 6 have practically duplicate surface equipments, with Nordberg hoists good for 6,500′. The mine has a complete equipment of air compressors, shops, etc., and a large number of dwellings occupied by employes. Water is pumped from Lake Superior for boilers, fire protection and domestic use. Crosscuts have been sent to the Calumet conglomerate at various depths, without encouragement.

The Tamarack Junior is a tract of 120 acres, ¼ mile wide by ¾ mile long, sandwiched between the Centennial and Calumet & Hecla, with 2 vertical shafts on the Calumet conglomerate. It has been worked at an actual loss for several years past, and was practically abandoned late in 1902, though exploratory work continues. The shafts would be valuable to the Calumet & Hecla for the development of a tract between the Tamarack Junior and Tamarack mines.

The North Kearsarge has 1,120 acres, north of the Wolverine, with which it is connected underground, and with which mine land has been traded to the extent of 13½ acres, to correct boundary lines with the strike of the lode. The Kearsarge amygdaloid runs 16′ to 20′ wide in this mine, and while bunchy shows some of the best stopes ever opened in the Lake district. About 3 miles of entirely new drifts have been opened by drift-stopes, without a pound of stoping, and the mine can produce 2,000 to 2,500 tons of selected rock daily, with ease, when desired, which rock should average fully 1¼% refined copper. The Kearsarge has 3 shafts, numbered south to north. No. 1 is being cut down to 3-compartment size and retimbered, this work being practically finished at the close of 1902. The shaft has a Nordberg hoist, good for 6,500′, operating two 6-ton skips in balance.

No. 2 is an old shaft and will go out of commission when the improvements at No. 1 are completed.

No. 3 is a new shaft, 1,500′ northeast of No. 2, and opens an enormous area of rich ground of exceptionally uniform values. It is one of the best shafts ever opened in the Lake district. The hoist is a duplicate of that at No. 1. A new stone compressor house at No. 1 shaft is nearing completion, also a combination machine and carpenter shop of wood, a frame warehouse, and an office building. There is a considerable number of comfortable dwellings for employes. The heirs of the late Abner Sherman sued the Osceola in 1902 for a ¾ interest in the S. W. ¼ of Section 5–56–32, which is part of the Kearsarge mine.

The South Kearsarge, formerly the Iroquois, with an area of 160 acres, lies south of the Wolverine and east of the Centennial. Work was begun in virgin ground in September, 1899, and at the close of 1902 upwards of 2 miles of drifts have been opened, from which not a pound of ore has been stoped. The best stopes are toward the Centennial line, and the lode has about the same width and general characteristics as in the North Kearsarge and Wolverine mines. There are two shafts, ample for all future requirements. These are 1,100′ apart and connected by trestle, No. 2 having a shafthouse only, rock therefrom being sent to the No. 1 rockhouse, which is exceptionally large and well equipped. The surface equipment of the South Kearsarge is mainly second-hand, but efficient and ample for several years to come. The South Kearsarge can furnish 1,000 tons of good stamp rock daily, with ease.

The two Kearsarges have a combined area more than four times that of the Wolverine, which they flank, and with present development and equipment are capable of an enormous production. The future of the company rests with them, and they are certain to make the Osceola one of the largest and most profitable mines in the Lake district. The mines of the Osceola company have been worked with short forces, and on part time, during most of 1902, when the production was 13,416,396 lbs., or a trifle less than in the preceding year. It is expected that the mine will start production on a heavy scale in February or March, 1903.

The Osceola has three stamp mills, on the shore of Torch Lake, adjoining those of the Tamarack. The old wooden mill was completed in January, 1886, and has four heads of an average daily capacity of perhaps 300 tons each. This mill is inefficient and should be worked only at a pinch. The second mill is 135x215′, completed November, 1899, with 3 stamps, having 20″ pistons with 24″ stroke, supplied with circular shoes and striking 100 blows per minute at 95 lbs. steam pressure. These heads have stamped above 550 tons each, on test. The screens are circular with ⅝″ openings, allowing the easy discharge of the coarse copper. The third mill stands in line with the other two and went into commission early in 1902. The building is of steel, 176x213′, and has 4 Nordberg heads of the 4-valve type, with cylinders 20x24″ and circular mortars having ⅝″ screens and hydraulic separators. About 20% of the copper secured in milling comes from the separators and 20% from the mortar discharges. There are 110 Hodge jigs, with quick eccentric return motion, also 6 round tables and one Wilfley table for each stamp, the latter taking headings from the round tables. The Osceola's newest mill is one of the finest, if not the best, in the Lake Superior district.

The boiler house, adjoining the mills and furnishing power for all three, is of steel, 43x150′, and has three 72″ 150-lb. pressure and nine 84″ 105-lb. pressure locomotive-firebox boilers of 250 h. p. each. Coal is brought to a 500-ton bin in railroad cars, over a trestle. An automatic ash discharge flushes water from a stand pipe every 3 minutes. Draft is furnished by a 150′ brick-lined self-supporting steel stack.

An Allis-Chalmers Corliss engine runs a Morgan-Gardner direct-current 220-volt generator of 100 kilowatt capacity, operating incandescent and enclosed arc lamps.

The Osceola and Tamarack pump house is 35x70′, of steel, housing a 40,000,000-gallon triple-expansion Nordberg pump, having 22″, 40″ and 60″ cylinders, with three 30″ horizontal plungers of 52″ stroke, and 42″ discharge. Water is secured through an 8′ tunnel, running 1,275′ under Torch Lake and drawing water through 3″ holes, thus guarding against clogging by ice. Rock is hauled from mine to mill by the Hancock & Calumet R. R.

The old sands of the Osceola at Hancock have been leased, on royalty, to M. R. Goldsworthy, for reworking.

**OSCEOLA GOLD & COPPER MINING CO. WYOMING.**

Office: Cheyenne, Wyo. Mine office: Rudefeha, Carbon Co., Wyo. Capitalized at $200,000, shares $1 par. Pitt Covert, superintendent. Said to have been sold to the North American Mining Co., in December, 1902, but statement not verified. Property adjoins the Ferris-Haggerty mine, and is supposed to carry extension of that company's veins. Has a limited amount of development work only, but is regarded as a valuable property.

**OSCEOLA JUNIOR MINING CO. WYOMING.**

Office: Rawlins, Wyo. J. M. Rumsey, secretary. Lands supposed to be in the vicinity of Rudefeha, Carbon Co., Wyo. No returns secured.

**OTAVI MINES & RAILWAY CO. GERMAN SOUTHWEST AFRICA.**

African office: Otavi, German Southwest Africa. Holds a concession for mining and railway rights in the northern part of the colony. Rich copper deposits are said to have been discovered at Gorob, to the north of Knisib, 93 miles north of Swakopmund, and this company is also investigating old copper mines at Guchab, Nagaib and Tsumeb.

**OTTUMWA COPPER CO. WYOMING.**

Office: Laramie, Wyo. C. B. Ritchie, president. Lands are in the Lake Creek district, approximately 40 miles southwest of Laramie. Property has a small amount of opening by shaft and tunnel.

**COMPANIA MINERA LOS OURAS. MEXICO.**

At Tepezala, Aguascalientes, Mexico. Gabriel Chaves, superintendent. Has copper and silver ores, opened by shaft. Uses animal power and employs about 40 men.

**SUCESION RAMON F. OVALLE. CHILE.**

Mine office: Carrizal Alto, Freirina, Atacama, Chile. Operate the Canto del Agua mine, opened 1870. Also own the Santa Margarita mine, 700′ deep, and about a dozen other properties. Product is smelted to matte, annual production being equal to about 600 tons of refined copper.

**OWOSSO GOLD & COPPER MINING CO. WASHINGTON.**

Company is practically out of existence, according to letter written by E. O. Burden, November, 1902.

**OXFJORDALEN COPPER CO., LTD. NORWAY.**

Offices: 23, Leadenhall St., London, E. C., Eng. W. A. Stearns, secretary. It cannot be learned that the company is doing any mining.

**OXIDE COPPER CO. ARIZONA.**

Office: 85 Ames Bldg., Boston, Mass. Mine office: Red Rock, Pinal Co., Ariz. T. K. Plancuel, superintendent. See Arimex Consolidated Copper Co.

**PACIFIC MINE. MONTANA.**

A developing property in the new district just east of Butte, Silver Bow Co., Mont. Opened by shaft, and has shipped ore averaging 12% copper. Owned by Butte Mine & Exploration Co.

**PACIFIC CONSOLIDATED MINING CO. NEVADA.**

Corporation by this title is said to have taken over the property of the Empire Copper Co., but statement has not been verified.

**PACIFIC CONSOLIDATED MINING & SMELTING CO. UTAH.**

Office: presumably Salt Lake City, Utah. W. F. Snyder, president; C. O. Ellingwood, secretary and treasurer. Organized October, 1902, with capitalization $1,500,000, shares $5 par. Company was formed to develop the Amy group of 29 claims in the Merrimac mining district of Utah. No returns secured.

**PACIFIC COPPER CO. MICHIGAN.**

Office and mining property: Houghton, Houghton Co., Mich. Organized August, 1890, under laws of Michigan, to work the Atlantic ashbed, on a tract of 960 acres northwest of Atlantic mine. A vertical shaft was sunk 90′ and a crosscut sent to the ashbed lode, which looked poorly, so work was stopped. Company had about $25,000 in treasury at last accounts.

**PACIFIC COAST COPPER CO. ALASKA.**

Capitalized at $5,000,000. Address not learned. Has 10 claims, 5 at Copper Mountain and 5 near Summit Lake on Prince of Wales Island, Alaska. Ore occurs as a slightly auriferous and argentiferous chalcopyrite in pyrrhotite.

**PAGOEAT COPPER CO. CELEBES.**

Said to be developing chalcocite and chalcopyrite ore bodies, 4′ to 5′ wide and averaging 10% copper, in the Dutch East Indies.

**PALM DEVELOPING CO.** **CALIFORNIA.**

Address: care of E. M. Ross and Jos. H. Call, Los Angeles, Cal., principal owners. A little development work has been done on claims 23 miles northeast of Acton, Los Angeles Co., Cal. Ore, mainly auriferous and argentiferous malachite, occurring as replacements in a porphyritic dike averaging 180′ wide and traceable 1½ miles. Has three shafts, deepest 125′. Mines were leased to Elliott & Leavitt, who erected a leaching plant, but water supply gave out. No returns secured.

**PAN-AMERICAN EXPLORATION CO.** **MEXICO.**

Office: 711 Missouri Trust Bldg., St. Louis, Mo. Mine office: Manzanilla, Colima, Mexico. Schuyler S. Gates, general manager. Mine is developed by a 200′ shaft and an 800′ tunnel, showing good ore values in gold, silver and copper. Property has water power and employs about 50 men. Company's holdings are regarded as valuable.

**PANUCO COPPER CO., LTD.** **MEXICO.**

Office: in London. Mine office: Panuco, Coahuila, Mexico. Chas. May, manager. Company has mines at Panuco and Romero Rubio, and circa 1898 was operating near Monclova, all in the state of Coahuila. Mines at Panuco are opened quite extensively by shafts and tunnels, and the property has a good steam plant. The ore, as mined, runs 10% to 12% copper and is concentrated to about 28% for export. Mining operations are upon a considerable scale and several hundred men are employed.

**PANULCILLO MINE.** **CHILE.**

Property of Central Chile Co.

**PAPAGO MINING CO.** **ARIZONA.**

Has a mine carrying copper-gold-silver ores, with steam equipment. Letter to company's address at Aztec, Yuma Co., Ariz., returned unclaimed, October, 1902.

**PAPOVSKI MINE.** **SIBERIA.**

Office: Semipalatinsk, Siberia. Owned and operated by Papov's Successors. Produced 3,586 poods of refined copper in 1899.

**PARADOX COPPER-GOLD MINING CO.** **COLORADO.**

Address not secured. Mining lands include the Mineral King mine, near Silverton, San Juan Co., Colo. Property is considered well located and of considerable prospective value. Company's funds exhausted, and efforts being made to raise needed cash, in November, 1902.

**PARAMATTA COPPER MINES, LTD.** **AUSTRALIA.**

Offices: 8, Princes St., London, E. C., Eng. Australian office: Brookman's Bldg., Adelaide, Australia. C. Clark, chairman; H. and W. Bickford, advisory board in Adelaide, Australia; L. G. Hancock, mine manager; G. St. G. D. Massey, secretary in London; H. L. Todd, secretary in Adelaide. Capital, nominal, £200,000; issued, £163,927. Property is 630 acres, in Wallaroo district, Yorke Peninsula, held on a 99-year lease at rental of 1 shilling per acre, plus 2½% royalty on net profits. This is an old and important Australian mine, and was reopened in 1900 by present owners. Vein runs up to 8′

wide, and in richest parts assays 25% copper. Production was resumed late in 1900.

**PARINGA COPPER MINES, LTD.** **AUSTRALIA.**

Had an office at 34, St. Mary's Axe, London, E. C., Eng., and property at Callington, Adelaide, South Australia. Letter to London address returned October, 1902, with notation "gone away."

**PARK GOLD & COPPER MINING CO.** **IDAHO.**

Mine office: Mullan, Idaho. Patrick Burke, superintendent. Has a 1,000′ tunnel, opening a 20′ vein said to run 8% to 30% copper. Company plans erecting a smelter.

**PARROT SILVER & COPPER CO.** **MONTANA.**

Mine office: Butte, Silver Bow Co., Montana. Harry A. Galway, superintendent. Has a stock issue of 230,000 shares, bulk of which is held by the Amalgamated Copper Co. This company is mixed up to some extent in the litigation that is so unpleasant a feature of mining operations in Butte. Principal mines are the Little Minah and Parrot, opened circa 1884. Company holds 19 claims in all, mostly well located. A barren zone occurs at a depth of about 1,000′, but good ore bodies are found below. Production is at the rate of about 12,000,000 pounds yearly. The ores carry fair values in silver and gold, as well as copper. Mine employs 300 to 400 men, when working full force. The Little Minah mine has a 1,000′ two-compartment shaft connected underground with the Nipper. The Parrot mine is about 1,700′ deep, main shaft having 3 compartments to 400′ level and 4 compartments below, connected underground with Colusa-Parrot, Never Sweat, Nipper and Original mines.

**PARRY SOUND COPPER CO., LTD.** **ONTARIO.**

Office: 604 Germania Life Insurance Bldg., St. Paul, Minn. Lands, about 14,000 acres, near Parry Sound, on the eastern shore of Georgian Bay, Ontario, showing bornite and chalcopyrite. The McGown mine has a 10-stamp mill, with Frue vanners, erected 1899. Company also owns the Wilcox mine, several miles distant, and produced a little ore in 1902.

**PASS CITY COPPER CO.** **MEXICO.**

Address: care of H. E. Runkle, secretary, El Paso, Texas. No returns secured.

**PATHFINDER CONSOLIDATED MINES, LTD.** **BRITISH COLUMBIA.**

Mine office: Grand Forks, Yale & Cariboo district, B. C. John Rogers, superintendent. Has gold, silver and copper ores, opened by shaft and tunnel. Steam power. Employs a small force. No returns secured.

**PAUDORNE COPPER MINING CO.** **VIRGINIA.**

Address: care of Wm. Leigh, Houston, Va. Organized December, 1902, under laws of Dakota, to do a general mining business in Virginia.

**PAYMASTER MINE.** **UTAH.**

Near St. George, Utah. No returns secured.

**COMPANIA MINERA LA PAZ.** **MEXICO.**

Mine office: Quatro, Cienegas, Coahuila, Mexico. Operates La Paz mine, producing silver and copper. Employs 75 to 100 men.

**PEACH BOTTOM COPPER CO.** **NORTH CAROLINA.**

At Elk Creek, Ashe Co., N. C. W. S. Greer, superintendent. Property consists of old workings showing a 4′ to 6′ vein of disseminated chalcopyrite, with a silver-lead streak lying on the footwall; mine also has a limited amount of cuprite and malachite. Was developing at last accounts, and had a shaft down 107′, with about 1,000′ of underground openings, assays giving 4.8% copper, $1.25 gold and $2 silver per ton.

**PEACOCK COPPER CO.** **CALIFORNIA.**

Office: 149 Broadway, New York. Mine office: Lavic, San Bernardino Co., Cal. Organized under laws of West Virginia, with capitalization $1,500,000, shares $5 par. Robert Dixon, president; H. B. Needham, vice-president; John W. Hussey, second vice-president; C. B. F. Palmer, secretary; Geo. A. Searles, treasurer; Newton Evans, general manager; C. F. Schrader, mine superintendent. Lands, 200 acres, in the Lavic district of San Bernardino Co. Ore, mainly chalcopyrite, well adapted to concentrating, assaying 8% to 10% copper, $2 to $5 gold and 8 oz. silver per ton. Formation is old lava flows, whence the name Lavic. Mine opened by 500′ tunnel. Has a 50-ton concentrator, 8 miles from the mine.

**PEAK MINE.** **AUSTRALIA.**

At Peak Downs, Stanthorpe district, Queensland. Mined native copper from an amygdaloid lode. Said to be rich, but entirely lacks transportation facilities. Idle for some years.

**PEAK COPPER CO.** **MICHIGAN.**

Address: care of W. L. Laffer, president, or H. T. Carleton, secretary, both of Cleveland, Ohio. Organized October, 1899, with capitalization $2,500,000, shares $25 par. Lands, 640 acres, in Ontonagon county, Michigan, six miles north of Bessemer, Mich. Two copper-bearing amygdaloids and one cupriferous conglomerate have been located; A little development work was done circa 1899–1900.

**PEARL COPPER MINING CO.** **COLORADO.**

Said to have copper claims in the vicinity of Pearl, Larimer Co., Colo., but letter to company returned unclaimed, October, 1902, from various post-offices in Colorado and Wyoming.

**PEARL & LILLIE MINES.** **COLORADO.**

Mine office: Newett, Chaffee Co., Colo. F. H. Denman, superintendent. Were opening a gold-silver-copper ore body by shaft, with steam power and small force, at last accounts.

**PELLON COPPER KING MINES.** **ARIZONA.**

Supposed to be in the vicinity of Tucson, Pima Co., Ariz., but no returns secured.

**PENA COPPER MINES, LTD.** **SPAIN.**

Office: 3, Laurence Pountney Hill, London, E. C., Eng. Mine office: Nerva, Huelva, Spain. C. H. Von Siemens, chairman; T. S. Dick, secretary; Mathesen & Co., 3, Lombard St., London, E. C., Eng., commercial agents. Capital, nominal, £450,000; issued, £400,000; debentures, £200,000, at 5%. Property consists of Pena del Hierro group of 17 old mines at Nerva, Huelva, Spain, formerly held by the Sociedad Peninsular, of Brussels, Belgium. No direct returns, and it cannot be learned that the company is doing any work.

**SOCIEDAD ANONYMA MINERA DE PENAFLOR. SPAIN.**

Office: Bilbao, Vizcaya, Spain. Mineral property includes the Concepcion, Descuido, and Preciosa mines at Penaflor, Sevilla, Spain. No returns secured.

**PEND D'OREILLE GOLD & COPPER MINING CO. WASHINGTON.**

Mine office: Davenport, Lincoln Co., Wash. J. B. Tuttle, manager. No returns secured.

**PENINSULA MINING & SMELTING CO. MEXICO.**

Address: care of Maj. G. H. Sisson, president, Los Angeles, Cal. Organized 1902, with capitalization $5,000,000. No returns secured.

**SOCIEDAD PENINSULAR DE BRUSSELS. SPAIN.**

Out of business. Mining property in hands of Pena Copper Mines, Ltd.

**PENN MINE. MICHIGAN.**

Address: care of J. H. Rice, Houghton, Mich. Lands, 1,440 acres, in Sections 35 and 36, Town 52 North, Range 37 West, and Sections 2 and 3 in 51-37, Ontonagon county, Mich. Was a part of the Belt Mines consolidation, but was not worked at that time. Property has been explored to a limited extent, last work having been done in 1901.

**PENN CHEMICAL WORKS. CALIFORNIA.**

Office: San Francisco, Cal. Mine office: Campo Seco, Calaveras Co., Cal. Albert C. Harmon, general manager. Is operating the old Campo Seco, Hecla and Satellite mines, which were considerable producers circa 1860-1870, the richest ores having been shipped to Swansea for reduction. Large quantities of medium and low-grade ores were left on the dumps, and these have since been leached from time to time. Ores, sulphides, associated with iron pyrites and carrying small percentages of gold, silver and zinc. Vein matter varies greatly, gangue ranging from talcose schist through clay to quartz. Is developed by 5 tunnels and has 2 shafts now working. The Hecla and Satellite mines are opened to depth of about 500′ each. Principal development is at the Satellite, where ore is being mined on four levels. Pyritic smelting is used, mine having a 100-ton water-jacket furnace. Material is matted three times, the last operation producing 60% matte. Mine and smelter employ about 100 men. In addition to smelting, the old ore dumps are being leached, and cement copper produced therefrom. Production at last accounts was at the rate of about 90 tons copper per month.

**PENNSYLVANIA MINE. WASHINGTON.**

Mine office: Egypt, Lincoln Co., Wash. C. C. May, superintendent. No returns secured.

**PENNSYLVANIA COPPER CO. NEW MEXICO.**

Office: Shamokin, Pa. Mine office: Albuquerque, Bernalillo Co., N. M. Employs three men. Organized 1901, under laws of New Mexico, with capitalization $100,000, shares $2 par. Thos. A. Lister, president and general manager; John Ring, vice-president; M. F. Nagle, secretary and treasurer;

Chas. W. Myers, superintendent. Lands, 9 unpatented claims, area 180 acres, showing 8 fissure veins, of which 1 is being opened, this carrying ore that has given smelter returns of 21% copper and 13 oz. silver per ton. Has incline shaft of 140′ and 50′ drift. Company will continue sinking the slope and install a steam hoisting plant in 1903.

**PENNSYLVANIA COPPER MINING CO.**

Office: Philadelphia, Pa. Incorporated December, 1902, under laws of Delaware, with capitalization. $2,000,000. No returns secured.

**PERCIVAL MINE. WISCONSIN.**

A prospect near the Chippewa mine, Douglas Co., Wis., on which a little work was done in 1898–99.

**CRESCENCIO PEREZ. MEXICO.**

Is operating a copper property near Mineral De Asientos, Aguascalientes, Mexico. No returns secured.

**FRANCISCO DE P. PEREZ. CHILE.**

Operates the Central mine, opened 1880, in the department of Santiago, Chile. Annual production, matte equal to 250 to 300 tons of refined copper.

**PERKIOMEN LEAD & COPPER MINES. PENNSYLVANIA.**

At Shannonville, Montgomery county, Pa. Once worked extensively and produced a large variety of copper and lead ores. Idle for some years.

**PERSON CONSOLIDATED COPPER & GOLD MINES CO. NORTH CAROLINA.**

Mine office: Virgilina, Va. Organized under laws of New York, with capitalization $1,000,000, shares $10 par. Employs about 90 men. E. B. Beecher, president. Lands, 1,372 acres, consisting of neighboring tracts, in Person Co., N. C. Said to have fair equipment, including a 90-ton concentrator completed October, 1902. Main shafts are 160′ and 330′ deep. Company is making weekly shipments of one carload each of ore and concentrates to smelter at New York, the smelting ore averaging 30% copper and 10 oz. silver per ton, and concentrates averaging 45% copper and 20 oz. silver per ton, with small gold values.

**DR. CARL PETERS' ESTATES & EXPLORATION COMPANY, LTD. RHODESIA.**

Offices: 96–98, Leadenhall St., London, E. C., Eng. Dr. Carl Peters, managing director; F. A. Matthaei, secretary. Capital, nominal, £150,000. Company has right to locate 1,500 claims on the properties of the Chartered Co., Mozambique Co. and Zambesia Co. About 40 copper claims had been so located at last accounts. Copper ores were found in the Melselter district of Rhodesia, by Dr. Peters.

**PETOSKEY MINING CO. ARIZONA.**

Mine office: Williams, Coconino Co., Ariz. R. Lyon, superintendent. Is developing copper ore by shaft. Has steam power, rolls and leaching plant.

**PEWABIC MINING CO. MICHIGAN.**

Mine at Hancock, Houghton Co., Mich., was opened 1853, closed 1884.

Mine now owned by Quincy mining Co.; Pewabic company had some assets remaining unliquidated at last accounts.

**PEYTON CHEMICAL CO.** **CALIFORNIA.**

Office: San Francisco, Cal. Is developing a prospect in the Diamond Springs district, El Dorado Co., Cal., showing a 6′ vein carrying copper, with a little silver and about $3 gold per ton.

**PHILADELPHIA COPPER & GOLD MINING, MILLING & SMELTING CO.** **MEXICO.**

Office: 317 Drexel Bldg., Philadelphia, Pa. Mine office: San Martin Hidalgo, Jalisco, Mexico. Employs 100 men. Organized 1900, under laws of New Jersey, with capitalization $300,000, shares $1 par. Edwin F. Hall, president; Dr. Stuart C. Runkle, vice-president; Francis J. Fee, secretary; Josiah G. Williams, treasurer; Augustine F. Paul, general manager; Michael J. Slattery, purchasing agent. Directors are preceding officers, Thos. B. Harned, Chas. F. Rieger and E. C. Tyrrell. Ernest Koch, mill superintendent; Braulio Medina, mining captain. Lands, 57 patented claims, area 141 acres, also 2-acre millsite, in the Ameca district of Jalisco, showing 14 fissure veins, of which 2 are being developed, these having average width of 12′ and length of 1,500′ with estimated average values of 7% copper, $20 gold and 2 oz. silver per ton, from sulphide ores. Lands include the Ajax, La Perla and La Concha mines, operations being on the Ajax. Mines have 8 shafts averaging 100′ depth and 6 shafts averaging 50′, with 2,800′ of underground openings and 80,000 tons of ore blocked out for stoping. Has 30-ton concentrator, equipped with two 40-h. p. Scotch marine boilers, 50-h. p. Corliss engine, 80-ton Sturtevant crusher and 40-ton Ellspass mill. Nearest railroad, Mexican Central, 18 miles distant. Has a 25-ton lixiviation plant and 6-ton trial plant now in operation.

**PHILADELPHIA & ARIZONA MINING CO.** **ARIZONA.**

Office: 614 Real Estate & Trust Bldg., Philadelphia, Pa. Mine office: Chloride, Mohave Co., Ariz. Employs 50 to 60 men. Organized 1900, under laws of Arizona, with capitalization $1,000,000, shares $1 par, non-assessable. H. T. Goodman, president; W. J. Cleeland, vice-president; E. F. Lukins, secretary and treasurer. Directors are preceding officers, Jos. Gazzam, J. H. Cleeland and Chas. P. Cochrane. D. T. Loy, general manager; F. R. Brooks, mill superintendent; W. F. Miller, mining captain. Lands, 2 patented and 14 unpatented claims, area 300 acres, in the Wallapai district of Mohave Co., Ariz. Ores, sulphide, in fissure veins, having average width of 6′, length of 1,000′′ and depth of 600′. Estimated values, 1% to 20% copper, $6 gold and 15 oz. silver per ton, with some lead. Has 20 shafts, from 20′ to 600′ deep each, with total of 2,000′ and a 3,500′ tunnel. Estimated amount of ore in sight, 100,000 tons. Has 150-ton concentrator, with two crushers, 3 rolls, 1 Chilean mill, 12 concentrating tables and 4 jigs. Will continue development work in 1903.

**PHOENIX MINE.** **AUSTRALIA.**

A property near Cobar, Robinson Co., New South Wales, in process of exploitation. Good copper ores have been secured on the 288′ level.

**PHOENIX CONSOLIDATED COPPER CO. MICHIGAN.**

Office: 11-13 William St., New York. Mine office: Phoenix, Keweenaw county, Mich. Organized April, 1899, under laws of New Jersey, with capitalization $2,500,000, shares $25 par, $9 paid in. John R. Stanton, president; J. Wheeler Hardley, secretary and treasurer; Frank McM. Stanton, agent; preceding officers, Wm. C. Stuart and J. Oppenheim, directors; D. D. Scott, superintendent; W. B. Childs, clerk; Edward Hall, mining captain; Con. Bedell, mill superintendent. Annual meeting, second Monday in March. American Loan & Trust Co., of Boston, transfer agent; Old Colony Trust Co., of Boston, registrar.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $800,000.00 |
| Amount paid in by conveyance of property to company | 500,000.00 |
| Entire amount invested in real estate | 505,000.00 |
| Amount of personal estate | 59,903.43 |
| Amount of unsecured or floating debt | 12,319.44 |
| Production of copper, 1901, in pounds | 93,643 |

Income for 1901 was $14,368.80, from copper and interest, while expenditures were $128,986.72, of which $8,074.74 was for construction and $112,769.79 was for working expenses at mine. Balance of assets, Jan. 1, 1902, was $47,583.99, and an assessment of $1 per share was levied in 1902.

The Phoenix Consolidated is the lineal successor of the Lake Superior Copper Co., which was the first regularly organized corporation to engage in Lake Superior copper mining. The history of the Phoenix under previous ownerships is given at some length in the 1902 edition of this work.

Mining lands of the Phoenix are 2,505 acres, comprising the old Phoenix, St. Clair and Garden City mines, also 80 acres of the Atlas mine tract. Lake Superior lies on the north; the Meadow, Humboldt and Eagle River properties on the east; the Atlas and Union on the south, and the Cliff mine on the west.

The Phoenix mine proper is not being worked by the present company. Five different fissure veins have been opened on this property, these being known as the Phoenix, East Phoenix, Armstrong, Ward and Robbins, the latter being worked by the present company under the name of the West Vein. The Phoenix proper was opened 1844 on the Phoenix fissure, and closed 1886, securing a total output of 7,773 tons, 39 lbs. refined copper. The largest mass of native copper ever found, weighing upwards of 500 tons, was taken from this mine. From 1873 to 1877, with Frank G. White as superintendent and W. E. Parnall as mining captain, the mine made money and paid one dividend of $20,000. For the 14 years 1872 to 1885, inclusive, the yield of refined copper was 473 lbs. per fathom stoped, or approximately 27 lbs. per ton. The Phoenix vein averages 3′ to 6′ wide, with nearly vertical dip and strike of N. 5° W. On this vein are two practically vertical shafts, the Tyler, 300′ and the Crocker, 780′ deep. There is also an incline following the dip of the stratified beds, from the Tyler shafthouse, with depth equivalent to

1,000′ vertically, this shaft nearly paralleling the "false slide" that underlies the greenstone.

During the past 60 years some 20 cupriferous fissures, mostly narrow and of small promise, have been opened on the lands of the present company. Mining has also been done on the ashbed lode, which is 5′ to 25′ wide, this being opened by an adit of about 400′, all in the lode. The ashbed is bunchy and not especially promising. The formation at the Phoenix presents some puzzling peculiarities. The Allouez conglomerate, found under the greenstone both east and west, is missing here, as are sundry other amygdaloid and conglomerate strata, noted on either side of the Phoenix tract.

In addition to the Phoenix mine proper the present company owns the Garden City, operated 1859–1868, and the St. Clair, operated 1865–1874 and 1880–1885, these mines having made 543 tons, 468 pounds refined copper.

The St. Clair fissure averages 18″ to 24″ width, carrying 2% to 3% copper, with a dip of 84° and strike of N. 15° W. The mine is very dry, not making enough water for the boilers on surface. The shaft was 8x10′ inside of timbers, with one skipway and a compartment for pipes and ladders. The mine was opened awkwardly by a 400′ shaft, practically vertical, from the bottom of which a drift ran 700″ north to the "false slide," on which a winze or blind shaft was sunk at an angle of 45°, and from which drifts were opened north on each level to the "true slide" underlying the greenstone at an angle of 27°. This plan of opening being entirely unsuited to modern mining requirements, the work of bringing the blind shaft to surface by an upraise was begun late in 1901 and the shaft was holed through to surface Sept. 18, 1902. The completed incline shaft, which entirely supersedes the old shaft, leaves surface at an angle of 32°, and on the fourth level, at the depth of 725′, changes to 42°, running 720′ further to the tenth level, a total depth of 1,445′. A new hoist and boilers have been installed, and headgear erected. Two-ton skips will be used. The rockhouse now building will have 15x24″ crushers, and will be completed before the stamp mill is finished. The shaft will go into commission early in 1903, and it is expected to yield about one-third of its product as heavy copper, judging from past returns. A drift-crosscut (drift on the fissure and crosscut on the formation) has been sent southward on the fourth level of the St. Clair shaft, giving a thorough cross-section of the rock strata. An amygdaloid bed 45′ wide and carrying a little copper was cut some 60′ south of the old vertical shaft.

The West Vein (Robbins) is 3′ to 6′ wide, with nearly vertical dip and strike of N. 16° E., corresponding neither in strike nor dip with the fissures or the stratified beds, which has given rise to the hypothesis that it is a branch vein, which is possible, though merely a supposition. The old shaft on the West Vein has been cut down, retimbered and deepened, and at the end of 1902 is nearing the eighth level, at a depth of 715′. The showing of copper has been almost uniformly good in the newly opened levels, and notably rich in mass copper on the sixth. A large amount of good stoping ground has been opened, against the starting of the new mill in 1903. Two-ton skips are used and the surface plant includes a remodeled hoist, boilers and air compressor. The rockhouse will have 15x24" crushers. Owing to the narrow veins, "baby" drills are employed, these using ¾" steel and weighing but 100 pounds without weights, permitting their easy handling in four-foot stopes and obviating the breaking of unnecessary quantities of wall rock, which would be unavoidable with power drills of ordinary size.

New shops were built and equipped in 1902. These are under one roof, with the following dimensions: machine shop, 30x60'; power house, 24x42'; carpenter shop, 30x60'. Extensive and successful use has been made of the numerous old buildings and their machinery equipments. The best of the old dwellings were remodeled and a number of new houses have been built. The mine location, with its substantial and well-painted mine buildings and houses for employes, is one of the neatest in the district, and the topography of the surrounding country is bold and picturesque. A dam with area of 300x700' and depth of 12' has been built across the Eagle river, impounding 3,000,000 gallons of water. A large stationary Worthington pump in the roundhouse connects with the dam, and 900' of hose affords fire protection. Mains and hydrants for domestic water supply may be added later. A site has also been cleared for a big dam to hold 7,000,000 gallons of feed-water for the mill, about three-fourths of a mile above the millsite.

A narrow-gauge railroad 3½ miles long, connecting mine and mill, went into commission in 1902. This has one locomotive, rock cars and flat cars, bought from the Wolverine.

There were three old stampmills on the property and foundations of others of yet more archaic type. These have been torn down, and in the demolition of the old Phoenix mill an immense amount of rough and fine copper was taken from the foundations. Forty barrels were filled and the balance placed in a stockpile. The new mill is on the Eagle river, about 2½ miles north of the mine, and 1½ miles above the village of Eagle River. At the close of 1902 the mill is housed in, and waiting for its machinery. It will have one stamp and 12 jigs from the old mill of the Wolverine, also 12 new Hodge jigs, 8 Overstrom and 4 Wilfley tables. The mill departs from accepted types in having no finisher jigs and no slime tables, the Wilfley tables taking the fines and the Overstrom concentrators caring for the slimes. The mill is of wood, on concrete foundations, and will have a daily capacity of about 300 tons of rock.

The Phoenix is employing about 200 men and the force will be materially increased when the mill goes into commission, in the spring or summer of 1903. The mine must remain a small one, unless some payable stratified bed is found and developed, but bids fair to make a profitable producer. It has been developed economically, but without niggardliness, and is being handled in the best interests of its shareholders.

**PIC COPPER & GOLD MINING CO. OF LAKE SUPERIOR, LTD. ONTARIO.**

A company that sold stock, and regarding which six months' efforts to secure information have proved unavailing.

**PIEDMONT COPPER MINING & SMELTING CO. VIRGINIA.**

Office: 320 Broadway, New York. Mine office: Elkton, Rockingham

**PITTSBURG & MONTANA COPPER CO. MONTANA.**

Mine office: Butte, Silver Bow Co., Mont. Donald B. Gillies, superintendent. Stock of company supposed to be owned principally by Franklin Farrell, former president of the Parrot company. Property is the McQueen placer and adjoining claims, located to the eastward of the recognized copper zone of Butte, and said to be showing good ore values from a vein 30′ wide, carrying considerable chalcocite at a depth of 500′ and developed by shaft to a depth of 800′. It is said that this ore averages about 10% copper, though some of it runs to 17%. Company is understood to be planning the erection of a smelter in 1903, and to contemplate the ultimate building and operation of sheet and wire mills. Is also said to contemplate using a new process of concentration, by which little or no water will be needed. Has two shafts; No. 2 shaft 800′ deep, will have a hoist good for 1,500′ depth.

**PITTSBURG & UTAH GOLD, SILVER, COPPER & LEAD MINING CO. UTAH.**

Supposed to have property in the Ophir district of Tooele Co., Utah. No returns secured.

**PLAKALNITZA MEDNA PLANINA. BULGARIA.**

M. Mavrokordato, of Constantinople, Turkey, holds a cession from the principality for this property, which is located at Plakalnitza, Vratza, Bulgaria. The Romans mined near by, some two thousand years ago. Property shows bornite and a little chalcopyrite, in a dolomitic country rock.

**PLANET COPPER MINING CO. ARIZONA.**

Offices: 405 Washington Bldg., Boston, Mass., and Mining Exchange, Colorado Springs, Colo. Organized 1902, under laws of Arizona, with capitalization $3,000,000, shares $10 par, non-assessable. N. H. Partridge, president; J. Stanley Jones, vice-president; Geo. H. Kimball, secretary; Chas. Crompton, treasurer; H. L. McCarn, superintendent. Lands, 10 claims, area 240 acres, also 10-acre millsite and 30 acres miscellaneous lands, on the Bill Williams fork of the Colorado river, near Aubrey, Yuma Co., Ariz. Ore occurs as bedded veins and lenses, with about 30 exposures, and 8 different ore bodies are being developed. One stope is 500′ long, with an average width of 50′ and depth of 40′. Ore is estimated to carry 6% to 20% copper. Considerable hematite exists on the claims. Ores developed so far are exclusively oxides, carbonates and silicates, the sulphide zone not having been reached. There are 12 shafts, from 20′ to 120′ in depth; 2 inclines, of 185′ and 325′, and 8 tunnels, longest 225′, with about 1,500′ of underground openings and 5,000 tons of ore in sight. Power is furnished by two Fairbanks & Morse gasoline engines. There is a concentrator and smelter, with crushers, blowers, 40-h. p. boiler and engine and 30-ton water-jacket blast furnace. Product is turned out as 98% black copper. Nearest railroad station, Yucca, Ariz., but new line surveyed. Company will deepen its shafts and continue work on 12 exposures of ore, also install a new 100-ton smelter in 1903. These mines have produced upwards of $500,000 worth of high-grade ore, running from 15% to 40% copper, and are regarded as a valuable property.

**PLATA COBRE MINING & TRANSPORTATION CO.** **ARIZONA.**

Mine office: Shultz, Pinal Co., Ariz. Wm. R. Benzie, president; Q. E. Hicks, secretary; A. R. Benzie, superintendent. Was opening gold, silver and copper ores at last accounts. No returns secured.

**PLATA COPPER MINING CO.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. No returns secured, and location of property, if any, unknown. See Excelsior Copper Co.

**LOS PLATINOS MINE.** **MEXICO.**

Owned by Juan H. Mendoza y Ca., Fuerte, Sinaloa, Mex. Mine is opened by shafts and tunnels, and produces copper and silver. Employs about 100 men.

**PLATTE CANYON MINING CO.** **WYOMING.**

Mine office: Wheatland, Wyo. Thos. Hunton, superintendent. Was working a few men on development, at close of 1902.

**PLENTY COPPER CO.** **ARIZONA.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Lands are in Pima Co., Ariz. See Excelsior Copper Co.

**PLUMAS COPPER MINING & SMELTING CO.** **CALIFORNIA.**

Mine office: Susanville, Plumas Co., Cal. E. S. Cornell, manager. No returns secured.

**PLUMAS MINING, MILLING & SMELTING CO.** **CALIFORNIA.**

Organized May, 1902, with capitalization $200,000, by A. Dragovich, J. S. Wilson, J. J. Martin, E. J. Hassfeather and J. N. Flannisch of San Francisco, Cal., to erect a smelter at Taylorsville, Plumas Co., Cal. No returns secured, and company not known in Taylorsville.

**PLUTO GOLD & COPPER MINING CO.**

Organized Dec. 16, 1902, under laws of Colorado. Location of office and property unknown.

**PLUTUS MINE.** **MICHIGAN.**

About 4 miles west of Lake Gogebic, in Ontonagon Co., Mich. Located circa 1862, by Algernon Merryweather. Has had a little prospecting work, showing a good copper-bearing amygdaloid.

**POCAHONTAS MINE.** **CALIFORNIA.**

Owned by Mrs. Abby Waller, Merced, Mariposa Co., Cal. Area, 160 acres. Has a mineral belt with several veins of cupriferous iron ore, between dioritic walls. Vein matter is mainly diabase and altered diabase. Principal vein, about 100′ wide; mineral belt, 1,000′ wide in places; ore bodies, in lenses, are said to carry 6% to 12% copper and $2.50 gold per ton; altered ores appear above the 100′ level; sulphides below. Has been a limited producer of high-grade carbonate and oxide ores.

**POCATELLO GOLD & COPPER MINING CO., LTD.** **IDAHO.**

Organized December, 1902, by E. C. Manson, G. H. Olmstead, et al., to develop copper claims on Pocatello Creek, about 8 miles east of Pocatello, Bannock Co., Idaho. The Moonlight claim is said to show a 2′ vein of high-grade sulphide ore.

**POLAND-HAMILTON MINE.** **ARIZONA.**

Gage & Murphy, owners, Providence, Yavapai Co., Ariz. John Gray, superintendent. Has gold, silver and copper ores; is developed by shafts and tunnels, and equipped with steam power. Employed about 25 men at last accounts.

**POLARIS MINING & MILLING CO.** **ARIZONA.**

Address: care of J. B. Schmitz, president, Denton, Texas. Mine office: Clifton, Graham Co., Texas. Organized February , 1902, and paid first dividend June 21, 1902. Was selling stock at last accounts.

**PONDILAI & VOLCAN GROUP.** **NEW CALEDONIA.**

Near Diahot, New Caledonia. Are prospects only, on which a little development work has been done.

**PONTIAC GOLD & COPPER MINING CO.** **NEW MEXICO.**

Letter to this company's address, Tres Piedras, Taos Co., N. M., returned unclaimed, November, 1902.

**POONA & MATTA DARRA.** **AUSTRALIA.**

Address: care of C. H. Hessey, Broken Hill Chambers, Adelaide, South Australia. The Poona adjoins the Moonta and Paramatta mines. Present status of property unknown.

**PORCUPINE MINE.** **COLORADO.**

Address: care of M. B. Sweeny, owner, Ashcroft, Pitkin Co., Colo. Danl. McArthur, superintendent. Was opening silver-copper ores with a small force at last accounts.

**PORTLAND COPPER MINING CO.** **WYOMING.**

Has copper property near Battle, Carbon Co., Wyo. Is equipped with steam power and sinking a shaft. Presumably controlled by Colorado Springs parties. No returns secured.

**PORTLAND MINING CO.** **BRITISH COLUMBIA.**

Office: 19 North 7th St., Terre Haute, Ind. Mine office: Aspen Grove, B. C. Employs 5 to 10 men. Organized 1901, under laws of British Columbia, with capitalization $15,000, shares 1 cent par, non-assessable. Andrew J. Crawford, president; Willard Kidder, vice-president; M. T. Hidden, secretary; G. A. Cenzman, treasurer; J. E. Bate, general manager. Directors are preceding officers, J. C. Kolsem, A. W. Wright, C. N. Murphy and Alvin M. Higgins. Lands, 4 patented claims, area 204 acres, also 160 miscellaneous lands, in the Aspen Grove district of British Columbia, showing 10 veins, of which 2 are being developed, these having given assays of 15% copper, 80 cents gold and 3oz. silver per ton, from carbonate and sulphide ores. Has 115' shaft and 32' tunnel. Company contemplates continuing development and installing a $25,000 mining plant in 1903, and may build a $20,000 smelter.

**PORTLAND-IMNAHA COPPER MINING CO.**

All debts paid and company disincorporated, September, 1902.

**PORVENIR DE SONORA MINE.** **MEXICO.**

The Coast Line Copper Co. was organized in 1902 to take over a property of this name, somewhere in Sonora, Mexico.

**POSTAL GOLD, PLATINUM & COPPER MINING CO.**

Office: 901-188 Madison St., Chicago, Ill. No returns secured and location of property unknown, but judging from title of company, lands are probably in Wyoming.

**EL POTULLO MINE.** **MEXICO.**

At Inde, Durango, Mex. Victoriano Mantos, owner. Has copper and silver ores; opened by shaft, with steam power equipment. Small force employed at last accounts.

**PRESIDENTIAL MINING CO.** **ARIZONA.**

Mine office: Patagonia, Santa Cruz Co., Ariz. W. G. Dumont, manager. Has auriferous and argentiferous ores, opened by shafts and tunnels. Employs a small force.

**PRESTON PEAK COPPER CO.** **CALIFORNIA.**

Office: 20 Broad St., New York. Mine office: Yreka, Siskiyou Co., Cal. Organized 1898, under laws of West Virginia, with capitalization $2,500,000. Chas. A. Lieb, president; Henry Mathey, vice-president; D. J. Newland, secretary. Lands, 5 claims, 1½ miles north of Preston Peak, Siskiyou Co. Country rock is diorite and ore bodies consist of a succession of chutes, some having a width of 20′ to 30′, carrying chalcopyrite disseminated in pyrite. Ore is said to average 10% copper, with small gold values. No returns secured in response to repeated requests.

**PRICE MINING & DEVELOPMENT CO.** **BRITISH COLUMBIA.**

Near Revelstoke, N. W. Kootenay district, B. C. Is developing a copper-gold-silver ore body of 6′ to 8′ width, by tunnels, with small force. No returns secured.

**PRIDE OF ARIZONA COPPER CO.** **ARIZONA.**

Office: 66 Broadway, New York. Mine office: McCabe, Yavapai Co., Ariz. Organized 1899, under laws of Arizona, with capitalization $5,000,000, shares $2 par. Harry C. Hart, president; Jas. H. Plummer, vice-president; H. H. Douglass, secretary; Chas. Rudolph, treasurer; L. D. Phillips, manager. Annual meeting, third Tuesday in January. Lands, near McCabe, Yavapai Co., Ariz., showing gold, silver and copper ores, in the Rebel mine and adjoining claims, opened by shaft and tunnels and equipped with steam power. Was employing about 20 men at last accounts.

**PRIDE OF THE WEST MINING & MILLING CO.** **ARIZONA.**

Office: 1801 Fifteenth St., Denver, Colo. Mine office: Washington, Santa Cruz Co., Ariz. Organized May 1, 1901, under laws of Colorado, with capitalization, $1,500,000, shares $10 par. First dividend of $15,000 was paid Oct. 15, 1902, and company was understood to be clearing monthly profits of $25,000 or better, at the close of 1902. Arthur R. Wilfley, president; Herbert E. Fiske, secretary; Jesse Scobey, manager.

Lands, originally 52 acres, are in Washington Camp, Patagonia district, Santa Cruz Co., and 15 new mining claims were added in 1902. Company also owns smelter site and water claims, near the mine. Nearest railway stations are Nogales, 20 miles west, and Patagonia, 20 miles north, over good roads. The mine, four miles from the Mowry, which was the pioneer mine of Arizona, was opened in 1870, but, owing to depredations of the Apaches, lack of transportation facilities and other drawbacks incidental to pioneer days, was never largely developed. Property was reopened in 1897 and has since been systematically and extensively opened.

The ore bodies occur as contact veins, in limestone, of good size and good average values. Custom smelters exacted large penalties, owing to the existence of considerable percentages of garnet and zinc blende. The reduction process now successfully used was devised by Mr. Arthur R. Wilfley, an expert in ore concentration.

The ore is first given a quick roast, driving off part of the sulphur and coating the particles with slightly magnetic iron oxide. After cooling, the concentrates are passed through a magnetic separator, which attracts the chalcopyrite, partly magnetized as before explained, while the galena, zinc-blende, quartz and garnet particles are passed on for further separation and treatment. The copper concentrates of partially desulphurized chalcopyrite average 12% to 15% copper. The tailings from the magnetic separator pass over Wilfley tables, where a second separation is effected, the product being an argentiferous galena, carrying 50% to 60% lead, and 100 to 120 ounces of silver per ton. The tailings from the Wilfley tables are then passed through another magnetic separator, carrying a higher amperage, the product of this process being the crushed garnet, suitable for flux, with a portion of chalcopyrite not secured in the first magnetic separation. The fourth separation is similar to the third, magnets of increased amperage taking out the zinc-blende, running 50% to 60% zinc. The fifth process consists of passing the residual tailings over a second series of Wilfley tables, where the residue of silver-lead ore is secured. The tailings from the fifth and final process go to the waste-dump, and it is safe to say that no inquiring metallurgist or slant-eyed Mongolian will ever grow rich from reworking them. With slight modifications this comparatively simple and inexpensive process of separation of incompatible mineral elements is adaptable to many mines now idle because their ores are contaminated with zinc.

The concentrator was increased to 200 tons capacity in May, 1902, and a new smelter was planned in June, 1902. The property is one of merit and is excellently handled.

**PRINCESS ADA MINE. WASHINGTON.**

At Marcus, Stevens Co., Wash. Chas. H. Alban, owner. Opened by tunnel. Copper ores are somewhat auriferous. Employs a small force.

**PRINCESS MAY MINE. BRITISH COLUMBIA.**

Near the Sunset property, on the Similkameen river, in the Yale mining district, B. C. Slight development work shows low-grade copper ore carrying $1 to $6 gold and 2 to 10 oz. silver per ton.

**PRINCESS ROYAL GOLD & COPPER MINING CO.**

Office: New Whatcom, Whatcom Co., Wash. Henry W. Parrot, president; W. B. Morse, vice-president; Samuel D. Slentz, secretary. Lands, sundry claims on Princess Royal Island, ores from which have given assays very high in copper, with $4 to $10 gold per ton.

**PRINCETON COPPER MINING & SMELTING CO. ARIZONA.**

Office: 39 Cortland St., New York. Lands, 3 patented and 3 unpatented claims, area 120 acres, in the Hartford district of Cochise Co., Arizona. Organized 1901, under laws of South Dakota, with capitalization $2,500,000, shares $1 par. Henry Hamburg, president; Henry C. Adams, vice-president and treasurer; M. J. Jurgens, secretary; Henry Hamburg, Henry C. Adams, C. Meyer Zulick and Gustave E. Beyer, directors. Ores are malachite, chalcocite and bornite, assays from some samples showing high values in gold. Has shafts of 22′, 30′ and 65′, also tunnels of 60′, 70′ and 200′. The Sonora and Bisbee railroads are 14 and 15 miles distant, respectively. Company states that beginning January, 1903, property will be developed on a large scale.

**PRODIGAL SON MINE. CALIFORNIA.**

Near Cayucos, San Luis Obispo Co., Cal. E. P. Loring, owner. Has limited development by shaft and tunnel, showing vein of about 7′, carrying auriferous and argentiferous chalcocite in quartz gangue, traversing syenite and serpentine.

**PRODUCE COPPER CO. ARIZONA.**

Mine office: Mayer, Yavapai Co., Ariz. Ben Blanchard, superintendent. Was developing by shaft with small force at last accounts.

**EL PROGRESO MINE. MEXICO.**

At Sabinal, Chihuahua, Mexico. A. E. Turner, owner. Ores carry silver, copper and lead. Is opened by shaft and has steam power. Employs about 25 men.

**EL PROGRESO COPPER MINING CO. MEXICO.**

Office: 67 Wall St., New York. Mine office: Ejutla, Jalisco, Mexico. Organized 1900, under laws of South Dakota, with capitalization $1,500,000, shares $1 par. David B. Russell, president; and general manager, Guadalajara, Mexico; W. E. Arnold, vice-president; Jas. H. Thornby, secretary; Benj. H. Irving, treasurer. Lands, about 80 acres, including La Margote, Restauradora, Abundiancia, Buena Esperanza, Santa Cruz and adjoining claims, supposed to have been opened by the Aztecs and some of which were certainly worked during the era of Spanish dominion. It is claimed that conservative assays establish average values of 12% copper, a trace of gold and 12 oz. silver per ton. Company made unreasonable promises of dividend returns when organized, but it is in the hands of reputable parties and is apparently worked and managed conservatively.

**PROTECTARO MINE. MEXICO.**

At Topia, Durango, Mexico. F. B. Najara & Co., owners. Has a gold-silver-copper ore body, opened by tunnel. Employed about 75 men at last accounts.

**PROVIDENCE GOLD & COPPER CO. CALIFORNIA.**

Office: 617 Homer Laughlin Bldg., Los Angeles, Cal. Mine office: Gold Stone, via Blake, San Bernardino Co., Cal. Employs 5 to 10 men. Organized 1901, under laws of Arizona, with capitalization $3,000,000, shares $1 par. T. H. Matthews, president; W. E. Baxter, vice-president; A. Samuel Parks, secretary; Los Angeles National Bank, depositary. Directors are preceding officers, F. H. Messenore, Jas. H. Dewey and C. Modena Wood. Geo. O. Kilbourne, mine manager; Geo. L. Berg, superintendent. Lands, 15 claims, in process of patenting, area 300 acres, also 8 millsites, area 40 acres, in the Arrow district of San Bernardino Co., showing a considerable number of fissure veins, 2′ to 16′ wide, giving assays of 10% copper with a trace of gold. Has 28 pits and shafts, from 10′ to 92′ in depth, and tunnels of 55′ and 208′ with 1,600′ of underground openings. For 1903 company contemplates driving the Gold Stone tunnel 4,000′ and the Lucifer tunnel 2,500′.

**PRUDENTIAL GROUP. CALIFORNIA.**

Near Shelly Creek, Del Norte Co., Cal. H. S. Reed, Medford, Ore., manager. Opened to limited extent by shaft and tunnel, showing 2 veins 25′ to 30′ in width. Ore is pyrrhotite, carrying copper, gold, silver and zinc in small percentages.

**PRUDENTIAL MINING & DEVELOPMENT CO. ARIZONA.**

Lands, 12 claims, adjoining the Buena Vista group of the Nogales Copper Co., in the vicinity of Nogales, Ariz. I. G. King, manager.

**PUERTECITO COPPER CO. MEXICO.**

Office: presumably New York. Company owns assets of the Sonora Copper Co., consisting mainly of a law suit against W. C. Greene for stock in El Cobre Grande Co., which company sold out to the Cananea Consolidated Copper Co., the stock of which is owned by the Greene Consolidated Copper Co.

**PUGET SOUND INVESTMENT CO. BRITISH COLUMBIA.**

Office: Irondale, Wash. Has copper claims in the southwestern part of Texada Island near Gillies Bay, one mile from an iron mine that is being developed by the company.

**COMPANIA MINAS Y FUNDICION DE PUQUIOS. CHILE.**

Mine office: Los Puquios, Rancagua, Chile. Owns and operates the Santa Rita, Ricardita, Morada and Magdalena mines, opened 1897. Company ships its product in the form of matte, and has just fairly begun operations on a considerable scale.

**PURITAN COPPER & GOLD MINING CO. NEW MEXICO.**

Benj. F. Coburn was president at last accounts. Property supposed to be near Tres Piedras, N. M. Company was criticized in last edition of this work for guaranteeing 10% dividends for five years on preferred stock. Letter sent to company's last known address in Boston returned November, 1902, after unsuccessful attempts by postal authorities to deliver to three different addresses. Moral: Beware of mining stock with guaranteed dividends. Such guarantees are worthless.

**PYRAMID COPPER CO.**

Organized under Maine laws, July, 1902, with capitalization $500,000, with $300 paid in. Company not found by postal authorities in Portland, Me., and it is not known what mining field the company has favored by the investment of $300 in cash.

**PYRAMID COPPER SYNDICATE, LTD. BRITISH COLUMBIA.**

Offices: Moorgate Station Chambers, London, E. C., Eng. Capt. R. B.

Needham, chairman; W. Smith, secretary. Capital, nominal, £20,000. Property, 16 acres, at Pyramid Camp, East Kootenay, B. C. No returns secured.

**PYRENEES COPPER CO., LTD.** **FRANCE.**

Offices: 15 Union Court, London, E. C., Eng. J. E. Anderson, director; H. B. Symonds, secretary. Capital, nominal, £150,000. Property, 1,704 acres in Basses Pyrenees, France. No returns secured.

**Q. S. MINING CO.** **WASHINGTON.**

Mine office: Conconully, Okanogan Co., Wash. S. H. Barron, superintendent. Was opening copper ore body by tunnel, with small force, at last accounts.

**QUEBEC COPPER CO., LTD.** **BRITISH COLUMBIA.**

Was working the Marguerite claims, near Deadwood, B. C. Letter to this address returned unclaimed, October, 1902.

**LA QUEBRADA GROUP.** **VENEZUELA.**

This group includes the principal mines of the Quebrada or Aroa district of Venezuela, which have produced about 60,000 tons of fine copper. Group includes the Cumaragua mine, having a vein of carbonate ore 1′ to 5′ wide; the Titiara, with vein 2′ to 25′ wide; the San Antonio, with vein of 3′ to 18′ wide and the Quebrada, having a vein 50′ to 75′ wide, 2,000′ long and of unknown depth, from which oxide and carbonate ores have been mined in the alteration zone, leaving a large body of sulphide ore, averaging probably 5% to 6% copper, in the lower workings. Idle since 1894.

**QUEEN MINING & MILLING CO.** **NEW MEXICO.**

Mine office: Cooney, Socorro Co., N. M. G. Brown, superintendent. Has a 15-stamp mill and steam plant, milling copper-gold-silver ores from the Copper Glen and adjoining claims. Was working about 50 men at last accounts.

**QUEEN OF ARIZONA COPPER CO.** **ARIZONA.**

Office: 517-10 Wall St., New York. Mine office: 26 Lawler Bldg., Prescott, Yavapai Co., Ariz. Capitalization $5,000,000, shares $1 par. F. A. Tuttle, president; E. N. Darling, secretary. Company has been operated mainly as a development and promotion corporation, and has extensive holdings in subsidiary mining companies. At close of 1902 was arranging to consolidate with the Belcher Gold Mining Co., the Bullwhacker Mining Co., the Empress Mining Co. and the Sunlight Mining Co., under the euphonious title of the Great Belcher-Bullwhacker Gold Mining Co. Company is said to possess merit, notwithstanding the hideousness of its proposed new name.

**QUEEN VICTORIA MINE.** **BRITISH COLUMBIA.**

At Beasley, 7 miles west of Nelson, B.C. Has a big bluff of copper ore, claimed to be 300′ wide and 400′ long, with rhyoli walls, in a diorite formation. Claimed property can be worked at a profit on ores returning $4 per ton.

**QUEENSLAND COPPER CO., LTD.** **AUSTRALIA.**

Offices: 6, Princes St., London, E. C., Eng. G. Grinnell-Milne, chairman; J. G. Tait, secretary. Allan Gibb, mine manager. Capital, nominal, £500,000, half 6% cumulative preference and half ordinary stock. Property, 1,650 acres freehold, near Mt. Perry, Queensland. Company owns the old Mt. Perry and Reed's Creek mines. First production was secured in May, 1902, when 175 tons of matte were shipped. Smelter has a 75-ton water-jacket blast furnace, newly built. Mines are opened by 15 shafts, of 120′ to 800′, and employ an average of 100 men. The Mt. Perry mine has 4 veins with an average strike of N. 40° W. Company does custom smelting and is building a tram line between mine and smelter. Company also works the Greenback, Potosi and Wolca mines, in the Wolca district, near Mt. Perry, and the Boolboonda and Edena mines, carrying copper-gold ores, in the Boolboonda district.

### QUEENSLAND MINES EXPLORATION CO. AUSTRALIA.

Mine office: Mt. Perry, Tenningering district, Queensland, Australia. Has a leasehold of 90 acres, including the Harper's Hill mine, and secured a limited production in 1901. Was employing 15 men at last accounts.

### QUEENSLAND PIONEER, LTD. AUSTRALIA.

Offices: 354, Salisbury House, London, E. C., Eng. Capital, nominal, £7,500. H. F. Smith, secretary. Is interested in a copper property in Queensland. No returns secured.

### QUINCY MINING CO. MICHIGAN.

Office: 45 Broadway, New York. Mine office: Hancock, Houghton Co., Mich. Incorporated 1848, under special Michigan charter; reincorporated March 6, 1878, for 30-year term, under general mining laws of Michigan, with capitalization $2,500,000, in 100,000 shares, par $25. Wm. R. Todd, president; J. C. Devereaux, vice-president; W. A. O. Paul, secretary and treasurer. Directors are W. R. Todd, J. C. Devereaux, Cleveland H. Dodge, Isaac H. Meserve, Walter P. Bliss and Don M. Dickinson. John L. Harris, superintendent; Jas. W. Shields, mill superintendent; Thos. Whittle, mining captain; Chas. K. Hitchcock, mining engineer; Jas. R. Cooper, smelter superintendent; Wm. Bath, smelter clerk. Employs about 1,600 men and runs 180 power drills. Total dividend payments to close of 1902 have been $13,920,000.

The following table compares figures of production, income, costs and dividends for the years 1898 to 1901, inclusive:

| | 1901. | 1900. | 1899. | 1898. |
|---|---|---|---|---|
| Mineral, pounds.......... | 27,778,268 | 18,491,749 | 17,886,680 | 20,056,942 |
| Copper, pounds........... | 20,540,720 | 14,116,551 | 14,301,182 | 16,354,061 |
| Gross receipts............ | $3,327,071 | $2,353,416 | $2,450,179 | $1,986,116 |
| Expenditures at mine..... | 1,601,535 | 1,162,411 | 969,741 | 887,886 |
| Construction account...... | 167,192 | 604,870 | 404,481 | 221,277 |
| Smelting and Miscellaneous | 206,303 | 157,381 | 183,869 | 191,385 |
| Net mining profit........ | 1,352,039 | 428,754 | 882,087 | 649,578 |
| Other income........... | 72,503 | 21,122 | 46,579 | 18,625 |
| Total net profit......... | 1,424,542 | 449,875 | 928,666 | 668,203 |
| Dividends .............. | 900,000 | 900,000 | 950,000 | 650,000 |
| Balance ................ | *524,542 | –450,125 | –21,334 | *18,103 |

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* Surplus.

– Deficit.

The deficits shown in the preceding table are the differences between net earnings and dividend payments, and came from the surplus.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $2,500,000.00 |
| Amount paid in by conveyance of property to company | 1,000,000.00 |
| Entire amount invested in real estate | 2,500,000.00 |
| Amount of personal estate | 1,271,307.85 |
| Amount of unsecured or floating debt | 415,633.83 |
| Amount due the corporation | 226,685.97 |
| Production of copper 1901, in pounds | 20,540,720 |

The following table shows statistics of production, costs, etc., since 1864:

| Year | Product | Yield fine copper per fathom broken | Price obtained | Cost per pound exclusive of construction | Number of miners | Average monthly contract wages |
|---|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Cents* | *Cents* | | |
| 1864 | 2,498,574 | 562 | 44.8 | 26.7 | 242 | $65.50 |
| 1865 | 2,720,980 | 501 | .... | .... | 212 | 57.53 |
| 1866 | 2,114,220 | 451 | 31.3 | 29.0 | 227 | 53.16 |
| 1867 | 1,921,620 | 526 | 22.7 | 18.9 | 167 | 50.83 |
| 1868 | 1,417,941 | 447 | 25.2 | 23.1 | 157 | 50.44 |
| 1869 | 2,417,365 | 446 | 21.9 | 16.7 | 210 | 51.10 |
| 1870 | 2,496,774 | 528 | 21.5 | 15.3 | 181 | 46.09 |
| 1871 | 2,409,501 | 441 | 22.8 | 15.2 | 104 | 47.08 |
| 1872 | 2,269,104 | 391 | 32.5 | 22.9 | 233 | 60.62 |
| 1873 | 2,621,087 | 491 | 26.5 | 18.6 | 223 | 62.42 |
| 1874 | 3,050,154 | 577 | 21.9 | 15.1 | 234 | 43.38 |
| 1875 | 2,798,281 | 485 | 22.7 | 15.8 | 217 | 46.74 |
| 1876 | 3,073,171 | 507 | 20.0 | 15.7 | 227 | 47.13 |
| 1877 | 2,837,014 | 467 | 18.6 | 15.1 | 247 | 43.79 |
| 1878 | 2,991,050 | 395 | 14.9 | 14.0 | 234 | 41.50 |
| 1879 | 2,639,958 | 403 | 16.3 | 13.7 | 212 | 38.76 |
| 1880 | 3,609,250 | 563 | 18.5 | 11.8 | 192 | 49.10 |
| 1881 | 5,702,606 | 766 | 18.7 | 10.6 | 212 | 48.54 |
| 1882 | 5,682,663 | 800 | 17.1 | 9.5 | 152 | 48.83 |
| 1883 | 6,012,239 | 850 | 13.7 | 8.9 | 165 | 46.02 |
| 1884 | 5,680,087 | 722 | 12.2 | 8.6 | 157 | 43.35 |
| 1885 | 5,848,497 | 710 | 11.4 | 7.5 | 132 | 44.00 |
| 1886 | 5,888,517 | 638 | 11.1 | 6.8 | 140 | 45.80 |
| 1887 | 5,603,691 | 781 | 11.7 | 8.6 | 142 | 48.40 |
| 1888 | 6,367,809 | 690 | 15.9 | 10.1 | 158 | 49.60 |
| 1889 | 6,405,686 | 690 | 12.0 | 9.4 | 145 | 49.15 |
| 1890 | 8,064,253 | 769 | 15.7 | 8.2 | 146 | 52.60 |
| 1891 | 10,542,519 | 685 | 12.8 | 9.1 | 182 | 53.40 |
| 1892 | 11,103,926 | 572 | 11.2 | 8.8 | 238 | 53.75 |
| 1893 | 14,398,477 | 574 | 10.4 | 7.1 | 259 | 49.60 |
| 1894 | 15,484,014 | 584 | 9.5 | 5.7 | 285 | 50.70 |
| 1895 | 16,304,721 | 517 | 10.1 | 5.9 | 336 | 50.00 |
| 1896 | 16,863,477 | 477 | 10.9 | 6.5 | 379 | 52.00 |
| 1897 | 16,924,618 | 481 | 11.1 | 6.8 | 393 | 52.52 |
| 1898 | 16,354,061 | 513 | 12.0 | 6.8 | 381 | 52.50 |
| 1899 | 14,301,182 | 427 | 17.0 | 8.1 | 401 | 56.72 |
| 1900 | 14,116,551 | 391 | 16.6 | 9.3 | 433 | 62.00 |
| 1901 | 20,540,720 | 409 | 16.1 | 8.8 | 533 | 62.00 |

The Quincy mine is opened on the Pewabic amygdaloid lode, having an average dip of 52° to 54° and running as flat as 43° at the depth of 4,000′ in No. 7, the southernmost shaft. The lode averages about 20′ wide in the old mine, with an extreme width of 40′, and is 10′ to 15′ wide in No. 8 shaft, on the Mesnard tract. The lode is very uneven in copper contents and a fairly equable production from year to year is secured only from extensive openings. About 25% of the mine's product comes in the shape of mass and barrel copper. In the upper levels, immense masses were frequently found, ranging up to 300 tons in weight, but the percentage of heavy copper is less at depth. The southernmost drifts of the Quincy are under the village of Hancock and 3,500′ below the mean water level of Portage Lake, while the northernmost workings, in the Mesnard shaft, are 1½ miles distant from the breasts of the southern drifts, with about a mile of the lode untouched on the Mesnard and Pontiac tracts north of No. 8 shaft. The walls are strong and little timbering is required, the cost being further reduced by the building of dry walls of waste rock in wide stopes, thus saving the cost of hoisting worthless rock and the expense of extra timbering. Fire-doors have been installed, and every precaution is taken against fire. Miners are carried to and from their work in man-cars holding 30 men. All hoisting cables are inspected frequently and every care taken to prevent accident to men or machinery.

The Quincy has several cupriferous amygdaloids in addition to the Pewabic, and was opened originally in 1848 on the Quincy amygdaloid, a parallel bed, lying some distance west of the Pewabic, but operations were unprofitable and were abandoned when the Pewabic lode was opened in 1856. There is a footwall branch, known as the Pewabic East Lode, underlying and paralleling the main bed, and at some points this underlying lode is rich and yields good returns. The so-called West Lode, 300′ west of the Pewabic, has been opened by crosscuts from the 36th, 39th, 40th, 44th and 49th levels, showing fairly well on the 39th and 40th levels, but poorly elsewhere. About 150′ west of the West Lode, there is another amygdaloid, averaging 10′ in width and carrying more or less copper, which may prove workable, with more extensive development. About 1,000′ west of the Pewabic is the Hancock amygdaloid, which is narrow, but fairly well mineralized, where worked in the old Hancock mine.

Owing to the absorption of the Pewabic and Mesnard mines, the numbering of the shafts is irregular. The southernmost is No. 7, followed by No. 4, 900′ north; next is No. 2, 575′ north; next No. 6, North Quincy, formerly the Pewabic, 1,900′ north of No. 2. The Franklin mine then intervenes, and to the north of the Franklin, No. 8 shaft is sunk on the Pewabic lode on the Mesnard tract, being 4,200′ north of No. 6.

No. 7 shaft, planned and supervised by Mr. Harris, is unique, being sunk on a catenary curve, leaving surface at an angle of 53° with the horizon, while at the 55th or bottom level, 4,700′ below the surface, the angle of inclination is but 43°. The shaft was sunk and raised in 5 different sections, for a distance of 4,000′, in 18 months, through extremely refractory rock. The steel shaft-rockhouse is 100′ high, with enormous wings, and is fitted with steam hammer and 5 Hodge crushers. The hoisting engine is an Allis-Chalmers direct-acting Corliss-type of 8,000 h. p., with cylinders 52x84″ and winding drums 28′ in diameter by 11′ 9″ face, carrying 8,000′ of 1½″ steel cable. The hoist can raise a 6-ton skip from a depth of 1½ miles at the rate of 3,000′ per minute, hoisting being limited to this rate by an automatic cut-off, which also prevents over-winding. Starting a load of 6 tons from a depth of nearly one mile, the hoist, if untouched, will raise the skip a few feet higher than the appointed place in the shafthouse, and check without damage of any sort. The main shaft, carrying the drum weighs 60 tons. The engine house is 58x94′, with adjoining boiler house 56x92′, both of stone with steel truss roofs. This shaft produces about 1,200 tons of rock daily.

No. 4 shaft is 4,300′ deep, to the 52d level, and will not be deepened, as a new hoist would be required for greater depth and the lower stretches of ground tributary to this shaft can be reached from No. 7. No. 4 continues an excellent producer.

No. 2 shaft is 4,900′ deep, to the 57th level, and the equipment is practically a duplicate of that of No. 7. The shaft is out of the lode at the bottom, and has been sunk one lift of 120′ to the 58th level, on the vein, giving a total depth of 5,020′.

No. 6, only 200′ south of the Franklin line, is one of the principal shafts of the Quincy, and is 4,900′ deep, to the 57th level. New skip tracks were laid and the shaft greatly improved in 1901, 8-ton skips being installed. The Allis-Chalmers hoist was given a new drum with diameter of 22′ 6″, early in 1902, providing capacity for hoisting from greater depth. An electric haulage plant was installed in this shaft in December, 1901, the Quincy being the first Lake Superior copper mine to make this notable improvement. Electric trams are in use on the 43d, 46th, 49th and 55th levels north, and on the 58th level south. The plant was installed by the General Electric Co., and power is furnished by the Houghton County Electric Light Co., but the Quincy management is considering the installation of an extensive power plant for generating electricity at the mills, and transmitting same to the mine. The tram lines are about one-third of a mile long each, with gradients of 1½%, toward the shaft. The electric locomotives stand 2′ high by 39″ wide and 9′ long, weighing 5,500 lbs. each, with drawbar-pull of 700 lbs. on a level track, and can pull four or five 3-ton rock cars at 6 to 8 miles per hour. One man cares for each train of 4 cars. The commercial current is taken by a 30-h. p. induction motor with motor generator, driving a 20-kilowatt direct-current machine with a voltage of 230, at 900 revolutions per minute. Five-hundred-ton bins have been built on the hanging-wall side of the shaft, ore being dumped into these by the tram cars, and fed therefrom into the skips, thus avoiding delays, both to the tram lines and the hoists.

No. 8 shaft, on the Mesnard tract, was 2,000′ deep, to the 15th level, on November 1, 1902, and sinking. This shaft is showing decided improvement both in width and quality of lode, at depth. The hoist at No. 8, taken from No. 2 shaft, is good for a depth of 4,000′. This shaft has a Rand compressor with 17x24″ cylinders and 12-drill capacity. The shafthouse is similar to those of Nos. 2 and 6, in design and equipment. Boilers, hoist and compressor are housed in a frame building.

The surface plant of the Quincy is the most complete in the Lake Superior district, excepting only the Calumet & Hecla. The new machine shop, near No. 2 shaft, is 62x145′, of stone, brick and steel, with truss roof and has a traveling crane covering the range of the entire shop. The equipment of machinery and tools is of the best, and the building is absolutely fireproof. Adjoining the machine shop is the new compressor house, 53x69′, of stone and steel, with fireproof truss roof, housing 2 Corliss 60-drill cross-compound, two-stage condensing right and left hand air compressors, so connected that air from them is available for use in any part of the mine. The cross-connection practically eliminates any danger of inadequate air supply happening through accidental disabling of either machine. A brick tunnel, plastered inside, connects the boiler house, machine shop and compressor plant, serving as a conduit for steam and air pipes. Steam from the compressor plant exhausts into a dam built for the purpose. The new blacksmith shop is 50x154′, with an ell 50x90′, of redstone finished ashlar, and fireproof steel truss roof, with three mammoth ventilators. The shop has 12 forges, fan, steam hammers, bolt-cutters, drills, grindstones, etc., and is the model smithy of the district. Near No. 7 shaft are 2 new boiler plants, each having eight 100-h. p. Roberts tubular return horizontal boilers, furnishing power for shafts Nos. 4 and 7, and part of the power for No. 2 shaft. A new boiler house at No. 6 is 56x75′, containing four 250-h. p. Wickes water-tube vertical boilers and a powerful fire pump, in addition to the old boiler plant with nine 100-h. p. horizontal locomotive firebox boilers. The coal yard is between shafts 2 and 4. Water for the boilers and mine location is taken from Portage Lake. The pumping station is of redstone, finished ashlar, and water is pumped for one mile against a head of 640′.

The Quincy mine location is very extensive, containing several hundred dwellings for employes, and is noted for its neatness. The newer houses are mostly of seven-room size, on solid stone foundations. The Quincy company, in addition to the mine location, owns extensive holdings of valuable land adjoining the city of Hancock, and portions of this ground are platted and sold from time to time, for residence purposes.

The Quincy & Torch Lake R. R., 6 miles in length, was built by the company in 1890, and touches all of the shafts and mine buildings at the mine, and the boiler house, wharves and coal shed at the mill, and is also connected with the Mineral Range and Hancock & Calumet railroads, and will be connected with the Copper Range railroad. The road is built and ballasted on the New York Central plan throughout, with a solid rock filling and ballasting, and steel bridges, having a continuous down-grade haul between the mine and mill. The equipment includes 6 locomotives and nearly 150 rock cars, also a number of freight cars. All of the newer cars have automatic couplers, air brakes and the latest improvements. The roundhouse is near No. 7 shaft and has an addition 36x40′, containing a special machine shop for the use of the railroad.

The mills are at Mason, on Torch Lake. The old mill, of wood, has 5 stamps with 20″ cylinders, Hodge jigs and 30 Wilfley tables. The new mill is 630′ north of the old, 132x216′ in size, of steel on stone foundations, with 180 windows, each having 13⅛ square feet of glass, giving a flood of light in every part of the building. This mill has 3 Allis-Chalmers stamps with 20″ cylinders. Foundations for each head consist of a deep and wide bed of timber and concrete, surmounted by a bottom plate of 22 tons, a middle plate of 18 tons and a top plate of 18 tons, all solid iron castings, above which is the mortar-box of the stamp. Finisher jigs and slime tables have been replaced entirely by 24 Wilfley tables, 8 to each stamp, thus giving one table to the fine sands and slimes from about 50 tons of rock daily. Each stamp has 12 rough jigs, 6 Wilfleys for finishing and 2 Wilfleys for slimes. The boiler house at the new mill is 56x90′, of steel on stone foundations, with four 250-h. p. Wickes vertical water-tube boilers and smokestack 100′ high on a 30′ foundation. The stamps at the new mill crush about 450 tons each daily, and both mills are working to their maximum capacity, treating about 3,300 tons of rock daily.

The pump house at the mill is 54x54′, of brick and steel on stone foundations, housing an Allis-Chalmers vertical triple-expansion pump, rated at 16,000,000 gallons, with actual capacity of 20,000,000 gallons daily. The old pump house has 3 pumps, with a combined capacity of 21,000,000 gallons daily. Water is taken from a 7x7½′ tunnel, driven 100′ under the bed of the lake. A 6x6½′ tunnel, 440′ long, connects the mills, boiler houses and pump houses, this being bricked and plastered inside and carrying both water and steam pipes. The mill has an electric light plant, machine shop and sundry minor buildings, and a considerable village has grown up about the works.

A Chilean mill was installed in 1902, regrinding coarse sands from the rough jigs. The jigging equipment includes 62 new improved Hodge jigs, 40 of which reinforce the rough jigs in the old mill.

The Quincy has 3 docks. One is at Hancock, with a wharf 40x416′ and warehouse 64x124′ with deep water in front and railroad tracks behind. A second dock is at the Ripley smelter, and has a 350′ shipping wharf for copper and a 250′ coal wharf. The third dock is at the mills on Torch Lake, wharf, being 40x400′ with 18′ of water alongside, built of Washington fir. On it stands a coal shed, 300x300′, of steel, with corrugated iron siding and roofing, having storage capacity for 80,000 tons of bituminous coal, this being about the annual consumption of the mine and mills. There are three coal hoists, these being steel towers, each 120′ high, traveling on a track 22′ wide and 300′ long running the entire length of the shed. The coal hoists are operated by steam power and can unload 100 tons each, per hour. The plant was built by the American Bridge Co., at a cost of about $200,000, and effects a saving of about 12 cents per ton on all coal used by the company.

The railroad reaches the shed by a 650′ trestle, partly of timber and partly with steel bents, supported on 240 concrete piers.

The smelter is at Ripley, opposite Houghton, and was blown in Dec. 1, 1898. The main building is 84x144′ of redstone finished ashlar, with 4 furnaces having 75′ stacks. In addition to the furnace building there is an old warehouse and a new frame warehouse 50x100′, also stone casting house, coal shed, cooper shop, engine house, etc., all of the most solid and pleasing construction. The plant was planned by Jas. R. Cooper, the smelter superintendent, and has effected savings netting the Quincy company about $100,000 yearly, equal to an annual dividend of $1 per share.

In 1889 the Quincy was crushing about 480 tons daily in its old mill at Hancock, while it is now treating about 3,300 tons daily. The Quincy holds the record for the lowest cost copper ever made by a Lake Superior mine, this having been 5.7 cents in 1894. The mine is magnificently equipped and should be a large and steady dividend-payer for many years to come. The output for 1902 shows a slight decrease from the preceding year, but should again exceed 20,000,000 lbs. in 1903. The management of the mine is now in new hands and at least a passing word of praise is due to the late Thos. F. Mason, so long the president; to Capt. S. B. Harris, for many years superintendent and now succeeded by his son, and to the late Geo. Bedell and his son, Con Bedell, who for 40 years were superintendents of the various mills. It was during their days that the Quincy was made the great and successful property that it now stands.

**QUINCY MINING CO. UTAH.**

The mine of the Quincy Mining Co., of Utah, was sold to the Daly-West, April, 1902.

**RADLEY & SHAW CLAIMS. BRITISH COLUMBIA.**

At Brown's Bay, Discovery Passage, Vancouver Island, B. C. Idle. Lands, 7 patented claims, area 268 acres, showing 4 ore bodies, either fissure veins or lenses, giving average assays 8% copper, $3 gold and 2 oz. silver per ton, from bornite. Claims are opened by three tunnels of 35′, 122′ and 256′. Owners will continue development in 1903.

**RAMBLER COPPER MINING CO. ARIZONA.**

Office: 110 So. Broadway, Los Angeles, Cal. Capitalization $500,000, shares $1 par. Lands, 7 claims, area 140 acres, said to be somewhere in the neighborhood of the United Verde mine at Jerome, Yavapai Co., Arizona. Has obtained ores showing 12% to 42% copper. No returns secured.

**RAMBLER COPPER MINING CO. WYOMING.**

Property transferred Oct. 1, 1902, to Rambler Mining & Smelting Co.

**RAMBLER MINING & SMELTING CO. WYOMING.**

Office: Laramie, Wyo. Mine office: Holmes, Albany Co., Wyo. Chicago office: care of M. M. Green & Co., fiscal agents, 145 La Salle St. Employs 40 men. Organized 1902, under laws of Wyoming, with capitalization $2,000,000, shares $1 par. Frank M. Wootton, president; Avery T. Holmes, vice-president; Milton M. Green, secretary; Arthur C. Jones, treasurer. Directors are preceding officers, J. T. Halliday, N. E. Corthill, Daniel

Bechtel, J. A. Swenson and Chas. W. Cheney. Wm. H. Webber, superintendent; Edw. E. Chose, consulting engineer. Lands, 10 claims, 2 patented, area 200 acres, at the head of Douglass Creek in the Medicine Bow Range, Albany Co., Wyo., at an elevation of 9,500′ above sea level. Holdings were increased in October, 1902, by purchase of the Isabella and Strangler claims, adjoining the original tract.

The Rambler mine was located 1870 and opened for gold by a 40′ shaft. Was relocated for copper and the Rambler Copper Co., organized September, 1900, under management of Avery T. Holmes, who deserves much of the credit for the successful opening of the mine. Original company was succeeded by the present corporation in October, 1902. The country rock is dioritic granite, no sedimentary beds being found in the neighborhood. Ore body is apparently a fault fissure in granite and should hold for a long distance. The mine is opened by the original shaft of 65′, from the bottom of which an incline runs on the vein at an angle of 45°, with three levels opened. The main working shaft, 175′, is vertical and connected with the original workings on the second level at 95′ and at the third level at 128′. There are shaft-houses at both shafts, the working shaft having a cage and 35-h. p. friction hoist. The mine has about 1,000′ of underground openings, and at the close of 1902 had 22,100 tons of ore, ranging from 20% to 45% copper, blocked out for stoping, on the first and second levels. The ore body was encountered at a depth of 65′ and has continued in all openings since made. The exact size of the vein is undetermined, but the ore body is evidently of considerable dimensions as well as exceedingly rich, giving assays ranging from 6% to 39% copper with average returns of about 33% copper from ore shipped in 1902. The ores are embedded in a gangue of decomposed granite, giving talcose alteration products and carrying more or less pyrite, hematite and marcasite, all useful fluxes and all carrying small percentages of copper. The gangue is easily separable, if concentration should be desired on the low-grade ores.

The Rambler is notable for its great variety of copper minerals, as well as for carrying metals never before found associated with copper, and has excited deep interest among scientists. The copper minerals are found in various stage of alteration and carry rare metals in commercial quantities, yet are comparatively free from such deleterious elements as antimony, bismuth and arsenic, so common in rich copper ores. The vein carries a little native copper, found associated with cuprite in the upper levels, and also gives melaconite, chrysocolla, chalcocite, covellite and chalcopyrite, the latter first appearing in small quantities on the second level. The mine is especially notable for carrying large quantities of covellite, which seems the home of the platinum. The list of metals carried in commercial quantities by the Rambler includes copper, gold, silver, iridium, osmium, palladium and platinum, the latter found as sperrylite, this being its only known occurrence with copper, platinum being found almost invariably with gold. Assays of Rambler matte made by the Chicago Copper Refining Co. gave the following values per ton of blister copper: 2.25 oz. gold and platinum, value $42.75; 6 oz. palladium, value $60; 6.75 oz. silver, value $3. These figures are contingent upon the ability of the company to find a market for palladium in considerable quantities at $10 per ounce. The cost of refining the matte and extracting the various rare metals and refining same will be approximately $40 per ton of blister copper, or 2 cents per lb.

The surface improvements at the mine include shafthouses, ore bins 21x44′, connected with shafthouses and smelter by trestle, carpenter shop, smithy, sawmill, smelter, office, assay office, stable, boarding-house and bunk-houses. The smelter has a 40-ton water-jacket blast furnace with engine, blower, pumps, crusher, dust-flue, etc., and was blown in about October, 1902. The great variety of copper ores and of cupriferous iron ores found in the gangue permits a furnace mixture that is absolutely self-fluxing. At the close of 1902 the smelter is treating 30 to 35 tons of low-grade ore daily, turning out the product as matte, while the high-grade ore is held in bins for shipment to Chicago, where the rare metals are saved. To the close of 1901 the mine has shipped 2,001 tons of ore, of the gross value of $85,951.67, giving an average return of nearly $43 per ton. Ore was formerly shipped to the Boston-Wyoming smelter at Encampment, but during 1902 has been sent to the Chicago Copper Refining Works. The ore is shipped 45 miles by wagon to the nearest railroad, which is expensive. The Laramie, Hahn's Peak & Pacific R. R., now building from Laramie to Centennial, has its line graded and ties distributed to within 12 miles of the mine at the close of 1902, and should be running trains about July 1, 1903. The Rambler claims and surrounding country are heavily timbered with spruce and pine, giving an ample supply of mine-timber and fuel, wood selling at $2 per cord delivered at the mine. The water supply is ample and at present the mine water is sufficiently pure for use in the boilers.

**RAMBLER EXTENSION MINE. WYOMING.**

Consists of the Big Nell and adjoining claims in Albany County, Wyoming. No returns secured.

**RAMMELSBERG MINE. GERMANY.**

At Goslar, Hartz Mountains, Germany. Works lenticular masses of cupriferous iron pyrites occurring in Devonian slates. Largest lense is 50′ wide by 3,500′ long, and of unknown depth. The mine is a considerable producer of copper.

**JOSE TOMAS RAMOS. CHILE.**

Owns the Chalinga mine, in the department of Illapel, Chile. Property was idle at last accounts.

**RAMSDELL-PARROT MINE. MONTANA.**

At Butte, Silver Bow Co., Mont. Is connected on 400′ and 500′ levels with the Colusa-Parrot.

**RANSON COPPER MINING CO. OF ONTARIO, LTD. ONTARIO.**

Office: Sault Ste. Marie, Mich. Organized 1902, under laws of Ontario, with capitalization $3,000,000, shares $1 par. B. Frank, president; Austin Lathrop, vice-president; David Rustander, secretary; David Cohn, treasurer; preceding officers, Geo. R. Brown, B. M. Morris, and J. I. Stanton, directors; D. J. Ranson, superintendent; R. H. Taylor, consulting mining engieer; John C. Bryne, mining captain. Lands, 3,600 acres, 6⅝ miles from Algoma Central railway, in Chesley and Anderson townships; Algoma, Ontario. Has 14 veins, of which 6 contact veins are being prospected; these having average width of 25′ and assay values of 12% copper and 3 oz. silver per ton, from sulphide ore. Has 8 shafts, of 23′ to 75′. Steam hoist, pump and drills. Company contemplates shipping ore without concentrating to smelter at Sault Ste. Marie, Ont.

**RARUS MINE. MONTANA.**

At Butte, Silver Bow Co., Mont. Owned by Montana Ore Purchasing Co., as near as can be ascertained, the property being the subject of numerous lawsuits. Is claimed by the Amalgamated Copper Co. that the Rarus is mining ore that apexes on the lands of the Boston & Montana, Butte & Boston and Parrot properties. Mine is well developed and employs about 400 men, when fully worked. Is thought to be one of the best mines of the camp. Vein is upwards of 300′ wide in places.

**RAWLEY MINING CO. COLORADO.**

Mine office: Bonanza, Saguache Co., Colo. David G. Weems, manager. Has lead-silver-copper ores. Steam and electric power. Employs about 15 men.

**RAY COPPER MINES, LTD. ARIZONA.**

Offices: 1, Gresham Bldgs., London, E. C., Eng. Sinclair Macleay, chairman. Capital, nominal, £360,000; issued, £260,000, with debentures of £93,700 at 6%. Property, mining claims, area 1,296 acres, on Mineral Creek, near Riverside, Pinal Co., Ariz. Opened by shafts and tunnels and equipped with steam and gasoline power. Has a 250-ton concentrator and a 6-mile narrow-gauge railway. Estimated amount of ore in sight, about 1,000,000 tons, averaging 4½% copper.

**READY PAY MINING CO. NEW MEXICO.**

Mine office: Hillsboro, Sierra Co., N. M. Is developing gold-silver-copper ores by shaft, with steam power. No returns secured.

**REBECCA COPPER MINING CO.**

Office: 542 The Rookery, Spokane, Wash. No returns secured.

**RED BIRD MINING CO. MONTANA.**

Office: Helena, Mont. Mine office: Austin, Lewis & Clarke Co., Mont. Employs 20 men. Organized 1902, under laws of Montana, with capitalization $1,500,000, shares $5 par, full-paid by purchase of property. S. J. Punches, president and treasurer; C. A. Punches, vice-president; J. M. Clements, secretary; R. A. Punches, superintendent. Directors are S. J. Punches, R. A. Punches, C. A. Punches, J. M. Clements and A. A. Pelletier. Lands, 4 unpatented claims, area 80 acres, in the Greenhorn district of Lewis & Clarke Co., showing 15 fissure veins, of which 6 are being developed, these having average width of 5′, length and depth unknown, with estimated average values of 21% copper, 45% lead, $5 gold and 35 oz. silver per ton, from oxide and sulphide ores. Company also has an iron ore body, averaging about 42% metallic iron. Has shafts of 200′, 350′ and 400′, with about 2,000′ of underground openings and 1,000 tons of ore blocked out for stoping. Has steam power and two hoists. Northern Pacific railway is 2½ miles from the mine. Company will continue underground development and install new hoist and boiler, and will pay dividend of 1 cent per share in January, 1903. Is shipping ore regularly to smelter at Helena.

**RED CLOUD MINE. MONTANA.**

At Garnet, Granite Co., Mont. Peter Mussigbrod, superintendent. Vein carries ores of gold, silver, copper and lead. Mine opened by tunnel, equipped with 10-stamp mill and steam power throughout. Was working about 35 men at last accounts.

**RED CLOUD MINING CO. CALIFORNIA.**

Mine office: Salton, Riverside Co., Cal. E. H. Gould, superintendent. Has gold-silver-copper-lead ores; opened by shafts and tunnels. Has steam and gasoline power, 2-stamp mill and 80-ton smelter. Employed 75 men at last accounts.

**RED FOX MINING CO. BRITISH COLUMBIA.**

Near McGuigan, Yale & Cariboo district, B. C. Geo. Alyard, superintendent. Was developing a cupriferous silver-lead vein by tunnel, with small force, at last accounts.

**RED ROCK COPPER CO. ARIZONA.**

Near Tucson, Pima Co., Ariz. J. C. Perry was agent at last accounts. No returns secured, and it is uncertain whether company is now in business.

**RED STAR MINING CO. WASHINGTON.**

Near Kalama, Wash. Essentially a gold mine carrying some cinnabar. A tunnel on the Copper Dyke claim shows about 2% copper.

**RED WING MINING & MILLING CO. UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. E. W. McGarrick, superintendent. Development is by tunnel, on auriferous and cupriferous silver-lead ores. Mine has steam power and works about 25 men.

**REDWOOD COPPER QUEEN MINING CO. CALIFORNIA.**

Office: San Francisco, Cal. W. P. Ferguson, president; Thos. Mellersh, secretary and treasurer. Lands, 840 acres, patented, 35 miles southeast of Ukiah, Mendocino Co., Cal. Development is by tunnels and winzes. Vein, much broken by faults, prominent on surface, has gossan capping, 2′ to 4′ wide, traceable for a mile. Country rock is brecciated porphyry and sandstone. Ores include azurite, malachite, cuprite, malaconite, tetrahedrite and chalcopyrite.

**REDDING GOLD & COPPER CO. CALIFORNIA.**

Office: Redding, Shasta Co., Cal. Thos. Gilbert, president; John White, superintendent. Company is developing sundry claims, including the Bedford group, north of Keswick; the Stabler group, north of Centerville; the Sky Blue group, at the mouth of Middle Creek, and others. Company is understood to contemplate erecting a smelter.

**REFORMA MINING CO. MEXICO.**

Address: given as Fuertes, Sinaloa, Mexico. Property is said to have copper-silver ores, developed by tunnel. No returns secured.

**COMPANIA MINERA LA REINA. MEXICO.**

Mine office: Cusihuiriachic, Chihuahua, Mexico. Ramon Navarro, president. Mine produces silver, lead, gold and copper and is opened by shafts and tunnels. Has gasoline power and three Huntington mills. Employs upwards of 100 men.

**REINDEER MINING CO. IDAHO.**

A. M. Strode, president, Mullan, Idaho. Is opening a vein said to show 2′ of 20% copper and 3′ to 6′ of concentrating ore.

**RELIANCE GOLD MINING CO. ARIZONA.**

Mine office: Prescott, Yavapai Co., Arizona. L. A. Davies, superintendent. Mines, including the Sundance, are at Groom Creek, Yavapai Co. Has 10-stamp mill, and steam power, securing a little copper as by-product.

**RESCUE COPPER CO. ARIZONA.**

Mine office: Ajo, Pima Co., Ariz. A. J. Shotwell, president. No returns secured and property idle at last accounts, but said to present a good showing for work done.

**RESOLUTE COPPER CO. MICHIGAN.**

Address: care of John F. Carey, president, Escanaba, Mich. Property is 1,120 acres, in sections 7, 18 and 19, 58–29, Keweenaw Co., Mich. Organized 1899, under laws of Michigan, with paid-up capital $25,000, shares $25 par. John D. Cuddihy, Calumet, Mich., vice-president; A. F. Heidkamp, Lake Linden, Mich., secretary; J. L. Nankervis, Calumet, Mich., treasurer. Main shaft, 379′; mine has about 2,000′ of drifting on various levels. Idle many years.

**RESTAURADORA MINE. ARGENTINA.**

In the Cerro de Capillitas district, Province of Tucuman, Argentina. Opened, circa 1850, and has been among the principal copper producers of the republic. Has a great variety of ores of high grade, but lacks transportation facilities. Idle at last accounts.

**REVENUE MINING CO. WASHINGTON.**

Office: 201 Northwestern Bldg., Minneapolis, Minn. Frank E. Plummer, president; Edwin Perry, vice-president; D. A. Simmons, secretary; Sterling Cross, treasurer. Organized 1901, under laws of Arizona, with capitalization $1,250,000, shares $1 par. Lands include Revenue group of 140 acres, with copper-gold ore, in Stevens Co., Wash.; oil lands in Utah; zinc and slate lands in Arkansas, and a gas franchise for town of Belton, Mo.

**REVENUE MINING & MILLING CO. WYOMING.**

Address: care of F. D. Russel, president, Denver, Colo. Was working a small force at last accounts.

**REWARD MINE. CALIFORNIA.**

Formerly the Cosmopolitan, in Plumas Co., Cal. Was a producer, circa 1863, but idle many years. Opened by tunnels and shaft.

**REWARD COPPER MINING CO. ARIZONA.**

Mine office: Vekol, Pinal Co., Arizona. Has copper-gold ores, opened by shaft. Equipment includes steam plant, 10-stamp mill and 20-ton cyanide plant.

**REWARD MINING CO.** **ARIZONA.**

Mine office: Florence, Pinal Co., Arizona. John Reiss, superintendent. Has steam plant and small smelter. No returns secured.

**REYNOLDS MINE.** **VERMONT.**

Near South Strafford, Orange Co., Vt., in the neighborhood of the Elizabeth mine. No returns secured and property thought to be idle.

**RHODE ISLAND COPPER CO.** **MICHIGAN.**

Office: 45 Broadway, New York. Mine office: Calumet, Houghton Co., Mich. Employs about 30 men. Organized 1899, under laws of Michigan, with capitalization $2,500,000, shares $25 par. Wm. R. Todd, president; W. A. O. Paul, secretary and treasurer; Thos. Dennis, superintendent. W. R. Todd, Isaac H. Meserve, Henry A. Wyman, C. J. Devereaux, John Baker and Jas. S. Dunstan, directors. Lands, 800 acres, north of Franklin Junior, in Houghton county.

Official returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $500,000.00 |
| Entire amount invested in real estate | 300,000.00 |
| Amount of personal estate | 34,794.42 |
| Amount of unsecured or floating debt | 3,378.57 |

Expenditures for 1902 were $39,040.80, leaving a balance on hand of $78,103.57, in addition to which there were assessments due but unpaid of $15,626.

Mining was begun November, 1898, on the Pewabic amygdaloid, which runs 8′ to 10′ wide on the Rhode Island's lands. No. 1 shaft is located 275′ north of the Franklin Junior boundary line and is 8x18′ in size and 500′ deep, well timbered, with three compartments. The copper is found near the hanging wall, where 2′ to 3′ of the lode is well mineralized at points. This shaft was abandoned at the beginning of 1902 and allowed to fill to the first level connecting with No. 2 shaft, which is 1,200′ to the northward and of the same size, with a frame shafthouse and Nordberg hoist capable of hoisting 2-ton loads from 800′ depth. A parallel amygdaloid, known as the West lode, about 8′ wide and showing occasional good ground, is opened from this shaft. The Allouez conglomerate has been opened by a crosscut driven east from the 4th level at a depth of 500′. The conglomerate averages about 19′ wide at this point and shows some good stamp-rock, but on the whole is not workable. No. 2 shaft was sunk 505′ to a point below the 8th level during 1902, and is now 1,000′ deep. Crosscuts are being sent both east and west from the bottom level. The east lode was cut at 32′ and found to be 5′ wide, carrying a little copper, but nothing especially encouraging. The west lode was cut 86′ from the shaft and found to be 9′ wide, carrying considerable copper. Drifts are being sent north and south on the west lode, which has produced several hundred pounds of mass copper and shows considerable good stamp rock. The east crosscut will be continued to the Allouez conglomerate, which will be opened if found satisfactory.

Surface improvements include machine and blacksmith shop 30x60′, and frame warehouse and supply office 30x50′, smithy and 15 dwellings. There is a 12-drill Rand compressor at No. 2 engine house and the mine has a full supply of pumps, power drills, skips, etc.

**RICHMOND & MONITOR MINES.** **MONTANA.**

Mine office: Saltese, Mont. Chas. J. Heidenreich, manager; Jerry Cooney, superintendent. Property is supposed to be owned by Minneapolis parties. Considerable money has been expended in development work. Ore shows considerable native copper, and assays running up to $60 per ton have been secured. Owners understood to plan building a smelter.

**RINCON MINING CO.** **ARIZONA.**

Address: care of B. J. O'Reilly, secretary, Naco, Ariz. Organized under laws of Arizona, with capitalization $2,500,000, shares $25 par. Lands, 27 claims, in Cochise Co., Ariz. No returns secured.

**RINGING ROCKS COPPER MINING CO.** **PENNSYLVANIA.**

Was doing a little exploratory work in the vicinity of Pottstown, Pa., in the fall of 1902. No returns secured.

**RIO ARRIBA CONSOLIDATED MINES CO.** **NEW MEXICO.**

Office: 1012 Herman Bldg., Milwaukee, Wis. Mine office: Tres Piedras, Taos Co., N. M. Lands show a system of parallel vertical fissure veins, running about 30′ in width, carrying auriferous and argentiferous copper ores with quartz gangue and talc-clay gouge. Assay said to show values of $10 to $50 per ton.

**RIO LUNA MINES CO., LTD.** **SPAIN.**

Letter addressed to company at Nottingham, England, returned unclaimed, October, 1902. Mineral property supposed to be at Campo La Lomba, Leon, Spain.

**RIO TENIDO COPPER MINES, LTD.** **SPAIN.**

Offices: 19–21, Queen Victoria St., London, E. C., Eng. J. S. Cropper, chairman; Louis Barre, mine manager; A. H. Greenhill, secretary. Captal, nominal, £150,000. Property consists of sundry mines between the lands of the Rio Tinto and Tharsis companies, in the province of Huelva, Spain. No returns secured.

**RIO TINTO MINE.** **BRITISH COLUMBIA.**

Near Queen Victoria group, at Beasley Camp, 7 miles west of Nelson, B. C. Has sulphide ores said to assay $10 per ton.

**RIO TINTO CO., LTD.** **SPAIN.**

Offices: 30, St. Swithin's Lane, London, E. C., Eng. Spanish office: Huelva, Spain. Mine office: Nerva, Huelva, Spain. J. J. Keswick, chairman; Maj.-Gen. Sir A. E. A. Ellis, C. W. Fielding, J. M. Macdonald, J. MacFarlan, L. C. G. Sartoris, directors; A. C. De Rothschild, J. M. Macdonald, trustees for mortgage bondholders; Turquand, Youngs & Co., auditors; J. G. Macleod and S. J. Bowes, joint secretaries; W. A. Carlyle, mine manager; R. E. Palmer, assistant manager; Gordon Douglass, mining engineer.

Registered March 29, 1873. Capital, £3,250,000, half in 5% cumulative preference shares of £5, and half in ordinary £5 shares. Warrants to bearer issued, in denominations of 1, 5, 10 or 25 shares. Mortgage bonds, £3,241,640, bearing 4%, redeemable at any time after June 30, 1905, on 28 days notice. Gross profits for 1901 were £1,811,149 and net surplus for the year was £1,366,876. Dividend payments were 5% on preferred and 72½% on common stock, giving a total of £1,254,805. Dividend payments for 1902 were 5% on preference shares and 57s. on ordinary shares, giving a total of £1,007,500, the last semi-annual dividend payment having been 22s, as compared with 35s. for the first semi-annual. Taxes paid in Spain for 1901 were £101,205. The Spanish system of taxation is complicated, cumbersome and burdensome, yet the tax payments of the Rio Tinto were only about 25% larger than those of the Calumet & Hecla, in Michigan, on practically the same production, in that year.

Lands of the company are about 16,000 acres of freehold, in the province of Huelva, Spain, of which 1,922 hectares are denominated strictly mining lands, the principal mining operations of the company being in a district having approximately two square miles area.

The Rio Tinto mines were probably worked by the Phoenicians, and certainly were operated by the Carthaginians, Romans and Moors, and were worked spasmodically by the Spanish government, until taken over by the present company in 1873. Prof. J. H. L. Vogt estimates that the ancient miners extracted no less than 20,000,000 to 30,000,000 tons of ore from these mines. Above some of the smelter slags left by the Phoenicians is a 10′ bed of alluvium, on top of which are the Carthago-Roman slags. The smelting practice of the Romans was very good apparently, the slags being as clean as those produced to-day. It is possible, however, that some of the copper originally remaining in the slags has been leached during the 2,000 years of partial exposure to the elements. There are many remains of old machinery, especially sheave-wheels, shafts, etc., evidently used as parts of hoisting machinery. These are invariably of oak; if iron was used for such purposes it turned to rust long centuries ago. There are also many potsherds, including miners' lamps of the classic pattern, and Roman coins are frequently upturned. The Roman system of mining apparently was to cut narrow seams and slab the ore off in large masses, either by quicklime tamped into the crevices and wetted, or by wedging, and perhaps both methods were used.

The Rio Tinto mines are in the Sierra Morena range and the topography is rugged. The ore bodies occur as mammoth lenses, with slate and clay walls on porphyry, and are surmounted by immense gossan cappings, considerably decomposed and quite easily broken and removed. The surface has been leached and is worthless, the zone of secondary enrichment beginning at approximately 100′ and continuing to about 300′ depth. The mine has 4 veins, or series of lenses, known as the North, Middle, South and Valley. Two of the mines are worked open-cast and two by regular underground mining. The principal drawback to underground mining is the scarcity and high price of wood for timbering. The underground mines are worked pillar-and-stall with a level every 12½ metres, levels being opened 4 metres high, and the entire floor divided into galleries and crosscuts of 4x4 metres, leaving pillars of 6x6 metres, which seems a rather ineffective method. The San Dionisio mine, on the Middle vein, is down to a depth of 300 metres, and the deepest shaft of the mine is approximately 1,200′. The principal workings are open-cast. The capping is sliced down in terraces, and the ore mined in terraces also, cars being brought in by locomotives to as great a depth as practicable, in stripping and quarrying. Engineers from the Rio Tinto visited the Lake Superior district in December, 1902, to study the open-cut methods of mining followed on the Mesaba iron range and the caving system used by the old-range iron mines of Lake Superior, with a view to introducing either or both methods, or suitable modifications, in Spanish mining. Diamond drill borings show untouched ore bodies of about 130,000,000 tons, giving sufficient reserves for about 70 years' production, at the present rate of output.

The ores carry an average of 1½ oz. silver per ton, with traces of gold, and considerable silver is saved by the Claudet process. The ores are rich in sulphur and are assorted into 3 classes, of which the smelting ore carries approximately 6% copper, the export ore containing about 3.5% copper and 45% to 50% sulphur, while the leaching ore averages 1.75% to 2% copper. The average percentage of copper carried by the ores treated has ranged from 1.5% in 1876, the first year of production, to 3.234% in 1884, the proportion of copper extracted in 1901 being 2.627%. The ores average 4% to 5% copper in the zone of secondary enrichment, and gradually decline in value with depth until at about 1,000′ the average is only about 1.25%. The ore bodies carry chalcopyrite, sparingly disseminated, say to an average of 7% to 8%, though higher in selected ores, in solid iron pyrites rich in sulphur.

Reserve heaps at the mines were estimated to contain 136,457 tons of copper at the beginning of 1902. The production of the mine for 1901 was 633,949 tons of shipping ore and 1,294,827 tons of smelting and leaching ore held for local treatment, a total product of 1,928,776 long tons of ore. The copper production for the past five years has shown practically no change, and was 34,464 long tons in 1901. Owing to their richness in sulphur, the shipping ores of the Rio Tinto are in good demand, and in addition to supplying various British works, are exported to Germany, France, Belgium and sundry seaboard acid works of the United States. The bulk of the medium-grade ore is shipped to the Cwm Avon works, where it is burned for sulphur, and the cinder treated by the Henderson wet process for the extraction of copper. In addition to mining a trifle over 2,000,000 tons of ore in 1901, about 3,000,000 tons of worthless iron capping were stripped from above the unleached ore. The production of the mine is divided into approximately 60% of blister copper from smelting ores and 40% of copper secured from the residue of ores shipped to the sulphur burners.

Machinery equipment on surface is very modest and cannot be compared with that of many second or even third rate copper mines elsewhere, owing to the system of mining and reduction followed by the Rio Tinto not calling for an extensive machinery plant. The methods of reduction followed by the Rio Tinto are explained at length in the chapter on mineralogy. The leach-heaps of the mine are estimated to carry 100,000 to 125,000 tons of copper, with upwards of 100,000 tons of copper in the terreros or waste-heaps.

The Sierra Morena has very heavy rainfalls, followed by protracted dry weather, rendering water storage necessary, and big dams have been built for that use. The ore retained at the mines for leaching is no longer calcined, the copper becoming soluble by natural weathering, assisted by irrigation. The use of scrap iron for precipitation has been superseded by the employment of pig iron from Bilbao. The Rio Tinto has extensive smelting works at Cwm Avon, Wales, and at the mine a new American smelting plant was blown in, January, 1902. This has 2 water-jacket blast furnaces, each 42x160″ at the tuyeres, with forehearths 4′ deep and 12′ in diameter. The production of the Spanish smelter was formerly shipped to Wales as matte, running 28% to 34% in tenor, but is now blown up to blister copper in a new bessemerizing plant, which has six 7-ton converters 80″ in diameter and 120″ long, quartzose cuprous ores being used for linings. The company contemplates adding an electrolytic plant to refine the blister copper at the mine.

The Huelva & Rio Tinto Railway is owned by the company, and runs 60 miles from the mines near Nerva to the port of Huelva, where the Rio Tinto has large shipping wharves and terminal facilities. This road does a general freight and passenger business, in addition to transporting ore, and returned profits of £14,694 in 1901. The Rio Tinto company also owns the steamer Don Hugo, of 1,249 tons registered burden, plying between Spain and Wales.

The mine employs nearly 10,000 men, at average wages of 15 reals, equal to about 60 cents, per day of 8 or 9 hours. There is no Sunday work and the labor is docile and efficient.

The management of the Rio Tinto is aggressive without being precipitate, and is both honest and capable. The financial and business management of the company is of the best type, and reflects credit upon the mining industry.

**RIO TINTO COPPER MINING CO. WYOMING.**

Organized September, 1902, under laws of Wyoming, with capitalization $1,000,000, by residents of Encampment, Wyo., and Lincoln, Neb. No returns secured.

**COMPANIA MINERA RIO TINTO MEXICANA. MEXICO.**

Office: Chihuahua, Mexico. Mine office: Terrazas, Chihuahua, Mex. Juan A. Creel, manager; D. Minnehan, superintendent. Property is quite extensively developed and its copper ores are both auriferous and argentiferous. Has a 300′ shaft and tunnels, with complete steam power equipment and 200-ton smelter. Employs about 250 men and is said to be making money.

**RIO VISTA GOLD & COPPER MINING CO. CALIFORNIA.**

Office: Chronicle Bldg., San Francisco, Cal. Organized under laws of South Dakota, with capitalization $1,000,000. D. E. McKinlay, president; E. P. Colgan, vice-president; A. G. Burnett, treasurer. Owns the Cosumnes mine, in Eldorado county, Cal. Lands, 2 patented claims, area 40 acres, showing a 30′ vein giving average assays of 15% copper and about

$10 gold and silver per ton, from malachite, chalcocite and bornite. Company estimates 100,000 tons of ore in sight.

**RIVERSIDE COPPER CO.** **ARIZONA.**

Office: Phoenix, Ariz. Mine office: Morristown, Maricopa Co., Ariz. Organized under laws of Arizona, with capitalization $2,000,000, shares $1 par. J. H. Graybill, vice-president; Isaac T. Stoddard, agent. Lands, 8 claims, 2 patented, in the Vulture Mountains of Maricopa Co., showing self-fluxing carbonate ores. The Copper Bottom claim shows a good body of slightly argentiferous galena. Property is well spoken of locally.

**LA ROCA-NEGRITA MINING CO.** **MEXICO.**

Mine office: Velardena, Durango, Mexico. Carlos Von Brandeis, manager. Works gold-copper-silver-lead ores. Employed 50 to 75 men at last accounts.

**ROCK LAKE MINING CO., LTD.** **ONTARIO.**

Office: Sault Ste. Marie, Ont. Mine office: Bruce Mines, Algoma, Ont. Employs 200 men. Organized 1899, under laws of Ontario, with capitalization $3,000,000, shares $10 par. M. Wile, president; Henry Weil, vice-president; L. C. Holden, secretary; B. G. Coryell, treasurer; A. S. Burrows, general manager. Directors are preceding officers, Morris Peccard, Louis Hexter and A. E. Dyment. D. McNee, superintendent; W. A. Madge, mill superintendent; Wm. Wearne, mining captain. Lands, 1,600 acres, in the Aberdeen district of Algoma, Ont. Ores are exclusively sulphides, occurring in fissure veins having an average width of 30′ and traced more or less continuously for upwards of 3 miles. Average copper content is estimated by company at 3%. Has one shaft of 425′ and 30 tunnels and crosscuts with about 2,000′ of underground openings and 100,000 tons of ore blocked out for stoping. Has complete steam plant with air compressors, power drills, etc., and 200-ton concentrator, equipped with crushers, quick-return jigs and Wilfley tables. Mine and mill are served by the Bruce Mines & Algoma R. R., built by the owners of this property. Company contemplates sinking a second shaft and opening 5,000′ of drifts, also doubling capacity of concentrator, in 1903. Property began regular shipments November, 1902 and has about three miles of veins stripped. Mine said to show increased values in lower levels.

**ROCKY MOUNTAIN COPPER CO.** **WYOMING.**

Office: Encampment, Carbon Co., Wyo. Property is in Wyoming or Colorado. No returns secured.

**BERNARDINO RODRIGUEZ.** **MEXICO.**

Supposed to be operating a copper property near Mazapil, Zacatecas, Mexico.

**SEVERIANO RODRIGUEZ.** **MEXICO.**

Name given by Mexican government as operator of a copper mine at San Pedro Ocampo, Zacatecas, Mexico. No returns secured.

**ROGERS COPPER & IRON CO.** **TENNESSEE.**

Office: McComb, Ohio. Organized June, 1902, under laws of South Dakota. C. H. Shuler, president; C. S. Hoskinson, vice-president; W. J.

Stark, secretary; C. C. Glecker, treasurer; J. A. Ewing, general manager. Property, 300 acres of copper and iron lands, near Ducktown, Tenn. No returns secured.

**LA ROMANERA GROUP. SPAIN.**

Near Paimogo, Huelva, Spain. At last accounts property was being investigated by Sres. Aznar y Ca., of Bilbao, Spain.

**ROROS KOBBERVAERK. NORWAY.**

This group of old mines, at Röros, near Trondjhem, Norway, was opened circa 1646, and includes the Storvarts, Kongens, Kristian VI and Muggruben, these being owned partly by the state. Employed 600 men in 1901. Production was 582 metric tons refined copper in 1898. Ores range 4½% to 5% in the Kongens group; 6% to 7% in the Storvarts, and about 5% copper in the Muggruben. A little prospecting has also been done on an adjoining group of claims.

**EL ROSARIO MINE. CHILE.**

At Tamaya, Ovalle, Chile. Owned by the Familia Lecaros. Mine was opened 1850 and is about 550′ deep. Not working at last accounts.

**ROSARITO MINE. MEXICO.**

At Fuerte, Sinaloa, Mex. Juan H. Mendoza, owner and manager. Produces copper-silver ores and is opened by shaft.

**ROSE MINE. CALIFORNIA.**

Address: care of R. S. Grant, owner, Victor, Cal. Property is in the Morongo district, 45 miles southeast of Victor, San Bernardino Co., Cal. Ores carry copper, gold and silver, the copper occurring in bunches and being hand-sorted and shipped to smelter. Employs about 20 men.

**ROSEMAN GROUP. CALIFORNIA.**

Owned by H. Roseman, et al, Redding, Shasta Co., Cal. Lands, 9 claims and smelter site. Ore, carbonate and oxide at surface, sulphide at depth. Property is slightly developed by shafts and tunnels. Idle at last accounts.

**ROSSLAND GREAT WESTERN MINES, LTD. BRITISH COLUMBIA.**

Offices: Salisbury House, London, E. C., Eng. Sinclair Macleay, chairman; Bernard McDonald, general manager; R. Desmond, mine manager; W. B. Mitchell, secretary; Capital, £500,000. Property, 78 acres near Rossland, B. C. Ores are gold-silver, with considerable copper secured as a by-product.

**ROSSLAND & SLOCAN SYNDICATE, LTD. BRITISH COLUMBIA.**

Mine office: Phoenix, Yale & Cariboo district, B. C. A. J. McMillan, manager. Has copper-gold ores on the Snowshoe claims, opened by shaft and tunnel. Has steam power.

**ROUILLARD COPPER MINES. NEW HAMPSHIRE.**

On Mt. Gardner, near Woodsville, N. H. Resumed work August, 1902, and erection of concentrating plant is contemplated.

**ROSEMONT COPPER CO. ARIZONA.**

At Rosemont, Pinal Co., Ariz. Wm. Kemp, manager. Has steam power equipment and 50-ton smelter. Was employing about 30 men at last accounts.

**ROWAN COPPER & GOLD MINING CO.** **NORTH CAROLINA.**

Office: Salisbury, N. C. Is working the old Oddie mine. R. D. Curd, superintendent. No returns secured.

**ROYAL COPPER MINING CO.** **UTAH.**

Name changed 1902 to Cactus Smelting & Copper Co.

**RUBY COPPER & GOLD MINING CO.** **WYOMING.**

Mine office: Collins, Wyo. John Van Liew, president and general manager; V. F. Thompson, secretary. Is driving a tunnel on claims near Camp Creek, to cut parallel veins located by shafts above.

**RUBY HILL COPPER MINING & SMELTING CO.** **CALIFORNIA.**

Mine office: supposedly Copper City, Cal. No returns secured.

**RUDEFEHA MINE.** **WYOMING.**

Synonomous with Ferris-Haggerty. Absorbed by North American Copper Co.

**RUDIANSKI MINES.** **RUSSIA.**

Address: care of P. L. Zamiatnin, Perm, Russia. Mines are in the Ural district of the government of Perm, Russia. Production was 86,473 poods refined copper in 1899.

**MARCOS RUSSEK.** **MEXICO.**

Said to be operating a copper property at Jiminez, Chihuahua, Mexico.

**RUTHBURG CONSOLIDATED COPPER CO.** **IDAHO.**

Office: Banigan Bldg., Providence, R. I. Organized under laws of West Virginia, with capitalization $1,000,000, shares $10 par. John Smith, president; Chas. W. Power, secretary. Lands, 112 acres, in the Seven Devils district of Idaho. No returns secured and it cannot be learned that company is doing any mining work.

**MINA DE RUY GOMES.** **PORTUGAL.**

Office: 4, Praca dos Romulares, Lisbon, Portugal. W. d'Orey, owner. A group of old mines in the San Domingo district of Portugal, producing cupriferous iron pyrites.

**SADO MINES.** **JAPAN.**

On the Island of Sado, Japan, 425 miles from Tokio. Mines yield gold-silver-copper ores. Owned by the Mikado until about 1898. Now operated by a private company. Property is exceptionally well equipped with the best mining machinery, and has employed as many as 3,000 men. Was used for years as a sort of practical mining school, when owned by the Mikado.

**SAGINAW MINE.** **MONTANA.**

At Jackson, Beaver Head Co., Mont. D. M. Wadams, superintendent. Is being opened by shaft and has steam power. No returns secured.

**SAGINAW VALLEY COPPER MINING CO.** **WYOMING.**

Office: Bay City, Mich. Mine office: Encampment, Carbon Co., Wyo. Organized 1902, under laws of Wyoming, with capitalization $2,000,000, shares $1 par, non-assessable. E. L. Beach, president; Alex. Zagelmeyer, vice-president; J. E. Hawkins, secretary; H. R. Marwinske, treasurer. Directors are preceding officers, C. C. Henning, Jairus A. Scott, John H. Davis, W. E. Barbey and B. E. Burgan. Jos. Walton, superintendent. Company makes no returns regarding its ore bodies, percentages, development or equipment.

**SAHUAYACAN MINING CO. MEXICO.**

Office: Pittsburg, Pa. Mine office: Jesus Maria Ocampo, Chihuahua, Mexico. Employs about 150 men. Leo Reed, manager. Operates the Veronica and other mines, producing gold, silver and copper. Main shaft, 350′. Has steam power and 20-stamp mill.

**ST. DAVIDS GOLD & COPPER MINES, LTD. WALES.**

Offices: 29, Cornhill, London, E. C., Eng. G. C. Isaacs, chairman; H. J. Wright, mine manager; J. Junner, secretary. Capital, £60,000. Property, 730 acres, carrying gold and copper ores, near Barmouth, North Wales, with royalty payable to the crown. Plant, 50 stamps and concentrator and limited quantity of copper concentrates is secured as a by-product.

**ST. GEORGE COPPER MINING CO. UTAH.**

Office: Salt Lake City, Utah. Mine office: St. George, Washington Co., Utah. Capitalized at $400,000. Clarence McCornick, president; Grant C. Snyder, secretary. Has gasoline power and a small smelter. Employs about 30 men.

**ST. JOE MINING CO. UTAH.**

Office: 61 Commercial Blk., Salt Lake City, Utah. Mine office: Bingham Canyon, Salt Lake Co., Utah. Capitalization $1,000,000, shares $1 par. R. A. Hasbrouck, president; Wm. S. Burton, secretary. Lands, 17 claims, area 340 acres, in the West Mountain district of Salt Lake Co. Has more than a mile of underground openings, including sundry shafts and tunnels. Principal opening is the St. Joe deep tunnel, which is to be about a mile in length and should open large ore bodies at great depth. No returns secured.

**ST. JULIAN MINING CO. MONTANA.**

Bought the Bercry, Bullion and Copper Queen claims, in the Emigrant division, near Livingston, Montana, in October, 1902. No returns secured.

**ST. LAWRENCE GROUP. WASHINGTON.**

Owned by W. R. Marion, et al, 312 Traders' Blk., Spokane, Wash. Lands, 4 claims, 2 of which show veins of gold-silver-copper ore, ranging 7′ to 30′ wide and assaying $20 to $40 per ton. Claims are in the Twisp mining district of the Cascade Mountains, about 60 miles from a railroad.

**ST. LOUIS MINE. NEW MEXICO.**

About 16 miles from Silver City, Grant Co., N. M. George Newcomb, manager. Was a producer in 1902, sending ore averaging 15% to 25% copper to smelter at Silver City. Mine is 500′ deep and quite wet. Alteration zone is about 200′ deep, below which are solid sulphides. Company is contemplating leaching ores of 5% to 20% in tenor.

**ST. LOUIS MINE. WASHINGTON.**

About 3 miles north of Silverton, Wash. Has a vein 18″ to 36″ wide, showing auriferous and argentiferous chalcopyrite assaying about 20% copper.

**ST. LOUIS COPPER CO. ARIZONA.**

Mine office: Gila Bend, Pima Co., Ariz. A. J. Shotwell, superintendent. Ores carry gold and copper. Equipment includes 10 stamps and steam plant.

**ST. MARY'S MINERAL LAND CO. MICHIGAN.**

Offices: 50 State St., Boston, Mass., and Houghton, Mich. Company is a reorganization of St. Mary's Canal Mineral Land Co., effected in spring of 1901, under laws of New Jersey, with capitalization $5,000,000 in 200,000 shares, $25 par. Company has 60,070 shares of stock unissued and owns all stock, except founders' shares, of St. Mary's Canal Mineral Land Co., organized 1863, under laws of Michigan, with capitalization $1,000,000. Nathaniel Thayer, president; Chas. J. Paine, vice-president; Arthur G. Stanwood, secretary and treasurer; R. R. Goodell, general manager.

Lands of company are very extensive and scattered along the Lake Superior copper belt, the principal holdings being on the South Range, southwest of Houghton, Mich. On Jan. 1, 1902, the company owned 103,897 acres in fee and held mineral rights to 7,276 additional acres. Other assets are 50,000 shares of stock of the Champion Copper Co.; 20,000 shares of Pacific Copper Co.; 25,000 shares of Mayflower Mining Co.; 842 shares of Winona Copper Co.; 122 shares of Trimountain Mining Co. and 86 shares of Baltic Mining Co. From 1863 to 1900 the old company paid cash dividends of $2,200,000, also stock dividends of one share Tamarack; one share Iroquois; 1½ shares Baltic; ½ share Winona and ¼ share Albany & Boston, on each share of St. Mary's stock. The last dividend, $4, was paid Nov. 28, 1899. Income of company for 1901 was $626,297, of which $374,209 was secured from land sales. Expenses were $352,561, of which $300,000 was for an assessment of $6 per share on stock of Champion Copper Co., and had on hand Jan.1, 1902, a cash balance of $273,735. Company has made diamond drill borings south of the Champion mine during 1901-1902, but without any decided results.

**ST. MICHAELS MINING, MILLING & REFINING CO. NEW MEXICO.**

Mine office: Tres Piedras, Taos Co., N. M. A. York, superintendent. Was developing gold-copper ores by shaft at last accounts.

**ST. PAUL MINE. COLORADO.**

At Red Mountain, Ouray Co., Colo. J. T. Braeden, owner; J. I. Sweet, superintendent. Property shows silver-lead-copper ores. Has steam plant and employed small force at last accounts.

**ST. REGIS COPPER MINING & MILLING CO. MONTANA.**

Mine office: Missoula, Missoula Co., Mont. Fred W. Wilson, superintendent. Is opening copper and gold ores by 2 tunnels and contemplated enlarging its concentrator at last accounts.

**SALIDA GOLD & COPPER MINING CO. COLORADO.**

Office and mines: Salida, Chaffee Co., Colo. Capitalization, $100,000. John Harrison, superintendent. Has a ten year lease on the Sedalia copper mine, about 4 miles from Salida, and purposes installing a leaching plant to treat a considerable body of 3% copper ore.

**SALMON RIVER MINING CO.** **NEVADA.**

Mine office: Contact, Elko Co., Nev. Moses Jones, superintendent. Ores carry gold, silver and copper. Has a gasoline power plant and small smelter.

**SALT LAKE COPPER CO.**

Office: 617 Dooly Blk., Salt Lake City, Utah. No returns secured.

**SAMPSON GROUP.** **BRITISH COLUMBIA.**

At Beasley, seven miles west of Nelson, B. C. Claims show promising outcrops of sulphide ores.

**SAMPSON MINE.** **UTAH.**

A silver-lead mine, showing a little high-grade copper ore, at Bingham Canyon, Salt Lake Co., Utah.

**COMPANIA DE SAN ANTONIO.** **MEXICO.**

Mine office: La Cruz, Tamaulipas, Mexico. Alex. Dozal, manager. Has copper-lead-silver ores. Mine opened by shafts. Employs about 50 men.

**SAN BERNARDINO COPPER CO.** **CALIFORNIA.**

Organized March, 1899, under laws of West Virginia, with capitalization $2,500,000, and $500 paid in. Property, 360 acres, presumably in San Bernardino county, California. No definite information secured regarding company or its property.

**SAN CARLOS COPPER CO.** **MEXICO.**

Office: 25 Broad St., New York. Mine office: Linares, Nueva Leon, Mexico. Employs about 500 men. Organized 1896, under laws of New York, with capitalization $100,000, shares $100 par, non-assessable. W. H. Nichols, Jr., president; W. H. Nichols, vice-president; S. H. Steele, secretary and treasurer; Edw. D. Self, manager. Mining lands, about 3,600 acres with other lands of 6,500 acres, are in the San Carlos district of Tamaulipas, Mexico. Smelter is at San Jose, Tamaulipas, Mex. Ores range from oxides to sulphides. Property is developed by more than 50 shafts and about 7 miles of tunnels, with total underground openings of about 10 miles. Nearest railroad, Gulf branch of Mexican Central, 40 miles from mines and smelter.

**SAN CRISTOBAL COPPER CO.** **NEW MEXICO.**

Office: 616-116 Broad St., New York. Mine office: Amizett, Taos Co., N. M. Lands, 1,850 acres, in Taos Co., also water rights, railroad franchise, etc. Present company absorbed the Rio Hondo Copper Co. Has veins carrying copper, silver, lead and gold. Was planning erection of smelter in 1901, but it cannot be learned that same has been erected.

**SAN DOMINGO GOLD & COPPER CO.**

Office: given as New York, without street number. Willis B. Troy, manager. No returns secured.

**SAN DOMINGOS MINE.** **PORTUGAL.**

Mine office: Pomarao, Portugal. Operated by Mason & Barry, Ltd. Was originally opened and extensively worked by the Romans. Output of 1899 was approximately 3,600 long tons of refined copper. Mine is opened for width of 200′ and length of nearly 2,000′. Produces cupriferous pyrites carrying under 1% copper, but with 45% to 50% sulphur. Cinder is leached for copper, after burning for sulphur.

**SAN FERNANDO COPPER MINING & SMELTING CO. CALIFORNIA.**

Office: Exchange Bldg., Colorado Springs, Colo. Mine office: Ensanada, Baja California, Mexico. Is working a small force on development. Organized 1894, under laws of Colorado, with capitalization $1,000,000, shares $1 par, non-assessable. F. M. Woods, president; H. E. Woods, vice-president; Warren Woods, treasurer; preceding officers, C. L. Arzens and Frank L. Pettingell, directors: John V. Smale, general manager. Lands, 80 pertenencias, showing 8 veins carrying oxide, carbonate and sulphide ores, with small quantities of gold and silver. Veins range 2′ to 6′ in width and assays average 6% copper.

**MINA SAN FRANCISCO. PERU.**

See Compania Minera Santa Inez y Morrococha.

**NEGOCIACION MINERA SAN FRANCISCO Y ANEXAS. MEXICO.**

Supposed to be operating a copper property near Mineral de Asientos, Aguascalientes, Mexico.

**MINAS DE SAN FRANCISCO Y OTRAS. MEXICO.**

Group includes the San Francisco de Paula and Las Amelias mines, at Pesqueria, Sonora, Mexico. G. V. Monteverde y Ca., owners and managers. Mine is opened by shafts and tunnels and carries gold-silver-lead-copper ore.

**COMPANIA MINERA DE LA SAN FRANCISCO DEL AZUL. MEXICO.**

Mine office: Matehuala, San Luis Potosi, Mexico. Employed 50 men at last accounts and was operating a copper mine opened by tunnels.

**FINCA SAN JOAQUIN. CUBA.**

About 30 miles northeast of Cienfuegos, Cuba. Was worked intermittently 1856-1885, ores having been shipped to Swansea and the United States for smelting, returning an average of nearly 20% copper. Vein ranges up to 30′ in width. Ores are azurite, melaconite, cuprite, bornite and chalcopyrite.

**SAN JOSE MINE. CHILE.**

At Tamaya, Ovalle, Chile. Owned by Silva & Rivas. Mine was opened in 1844 and is 517′ deep. Present status unknown, but property thought to be idle.

**MINA DE SAN JUAN. SPAIN.**

At Paimago, Huelva, Spain. In charge of Don Jose de Soto. Lands, 102 hectares, with 4 old mine openings. Was in process of exploitation at last accounts.

**MINA SAN JUAN DE MALAJA. CUBA.**

About 6 miles northeast of Santa Clara, Cuba. Has 100′ gossan outcrop. Property has had only limited development, but it is said to be promising. Idle at last accounts.

**SAN JUAN MINES. CHILE.**

An important group of properties at Copiapo, Atacama, Chile, originally opened for silver, which was gradually replaced by copper, at depth. Deepest shaft is down about 1,800′.

**SAN JUAN MINING CO.** **COLORADO.**

Mine office: Central City, Gilpin Co., Colo. J. I. Perkins, manager. Has gold-silver-copper ores, opened by shaft. Steam power and employed about 20 men at last accounts.

**SAN LORENZO MINES.** **MEXICO.**

The San Lorenzo and Allende mines, of 36 pertenencias, area about 90 acres, in the Ures district, Sonora, Mexico, were bought by Frederick A. Platt, et al, in 1902, and are being developed. The San Lorenzo has a 4′ vein assaying as high as 18% copper and 30 oz. silver per ton. The Allende is not so rich, but is said to be a promising property.

**SAN LUIS MINING CO.** **MEXICO.**

Mines and works at Ocampo and Panuco de Coronado, Durango, Mexico. Company controls a large area, including some of the best mines of the district, and has properties rich in gold, silver, copper and lead.

**COMPANIA MINERA SAN LUIS.** **MEXICO.**

Mine office: Tepezala, Aguascalientes, Mexico. Juan A. Levano, superintendent. Ores carry exclusively copper values. Mine is opened by shaft and uses animal power. Employs about 40 men.

**SAN MARCEL MINE.** **ITALY.**

An old mine, of limited production, in Piedemont, Italy.

**SOCIEDAD MINEIRA DE SAN MIGUEL DE HUELVA.** **SPAIN.**

Office: Lisbon, Portugal. Mine office: Almonaster, Huelva, Spain. Lands, 112 hectares. Production of refined copper in 1899 was 789 long tons.

**COMPANIA MINERA DE SAN MIGUELITO.** **MEXICO.**

Said to be operating at Cumpas, in the Moctezuma district of Sonora, Mexico. No returns secured.

**SAN PEDRO COPPER CO.** **NEW MEXICO.**

Was mining at San Pedro, Santa Fe Co., N. M., circa 1899. No return secured, and property thought to be idle.

**SOCIETE ANONYMA DES MINES DE SAN PEDRO.** **SPAIN.**

Office: Rue de Chateaudun, 36, Paris, France. Mine office: Zalamea la Real, Huelva, Spain. Mines include the Barranco de Los Buyes, area 64 hectares.

**COMPANIA MINERA DE SAN PEDRO DE NOLASCO.** **CHILE.**

Mine office: San Pedro de Nolasco, Victoria, Chile. Company owns the Carlotta mine, one of the oldest in the republic, the property having been opened in 1795. Development is by a 700′ tunnel.

**MINA SAN PLATON.** **SPAIN.**

Property, 46 hectares, near Almonaster, Huelva, Spain. In charge of Don Antonio Ruiz Cancela, Sevilla, Spain. Supposed to be idle.

**SAN REMO COPPER CO.** **ARIZONA.**

Letter to Gleeson, Cochise Co., Arizona, where company claims to have mining lands, returned unclaimed, October, 1902.

**MINA DE SAN TELMO.** **SPAIN.**

Address: care of Ibarra e Hijos, Sevilla, Spain. Property, in process of exploitation at last accounts, is 222 hectares, at Cortegana, Huelva, Spain.

**SAN TOY MINING CO.** **MEXICO.**

Office: Milwaukee, Wis. Mine office: Chihuahua, Mexico. T. H. Bowles, president; M. R. D. Owings, vice-president; A. S. Witherbee, secretary and treasurer. No returns secured.

**SANTA BEATRIZ MINES.** **MEXICO.**

At Magdalena, Sonora, Mex. S. H. Pearce, owner; Richard Pearce, superintendent. Was opening a gold-copper property, by shaft, with steam power and small force, at last accounts.

**SANTA CRUZ MINING CO.** **ARIZONA.**

Office: Stockyards, Kansas City, Mo. Mine office: Patagonia, Santa Cruz Co., Ariz. Is developing with 10 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par. W. W. Hall, president; J. H. Hartewick, vice-president; Geo. W. Bolen, secretary and treasurer; W. M. Schwartz, general manager at mines. Lands, 6 unpatented claims, area 124 acres. Ores are carbonates and oxides. Has shafts of 60′ and 150′ and has 2 tunnels started. Has a fissure vein, said to be 8′ wide at surface and 20′ wide at depth of 60′, and traceable 3,000′, averaging 10% copper and 20 oz. silver per ton. Company contemplates sinking 300′ and building a concentrator in 1903.

**SANTA EMILIA COPPER CO.** **MEXICO.**

Office: 69 Wall St., New York. Mine office: Coapa, Michoacan, Mexico. Employs 60 men. Organized 1899, under laws of Delaware, with capitalization $1,000,000, shares $1 par. John A. Kennedy, president; Albert J. Peyton, vice-president and general manager; M. L. Ward, secretary; David Buchanan, treasurer; Jos. G. Collinson, superintendent; J. R. Crum, mining engineer. Lands, 83 acres, in the Tacambara district of Michoacan. Principal development is by the Napoleon tunnel, about 1,200′ long, and driving. Also has a new shaft sinking, with shafthouse and steam plant. Work planned for 1903 includes sinking shaft to depth of 800′ and continuing tunnel to length of 4,000′. Has a crosscut 110′ at the end of 1902, driving to cut the vein. Machinery equipment includes a 50-h. p. Lidgerwood hoist, 100-h. p. marine boiler and 200-h. p. dynamo. Company does not contemplate erection of smelter, but may install a concentrator. Assays show good values in copper and high values in silver.

**SANTA FE GOLD & COPPER MINING CO.** **NEW MEXICO.**

Office: 11 Broadway, New York. Mine office: San Pedro, Santa Fe Co., N. M. Mine and smelter closed down late in 1901 and future operation of property is dependent on price of copper. The mine can make money with the metal selling at about 15 cents. Organized 1899, under laws of New Jersey, with capitalization $2,500,000, shares $10 par, being a reorganization of the original company, formed 1888 and bankrupt 1892. Present company begun business with $500,000 cash; balance of assets Jan. 1, 1902, was $197,892. The 1901 copper production of the mine was sold for $222,255. Annual meeting, fourth Tuesday in January. J. H. Susmann, president; Edgar Buffum, secretary and treasurer; J. T. McLaughlin, manager; R. S. McCaffrey, superintendent. Lands, 3,400 acres of mineral property and 46,000 acres of miscellaneous lands, in the old San Pedro land grant of Santa Fe Co., N. M. Mine is opened by a single shaft on a blanket vein of sulphide ore, running150′ to 175′ thick and dipping at less than 15°. The ores smelted in 1901 gave average returns of 4.75% copper, $1.50 gold and $1.50 silver per ton, the slags showing about 0.5% copper. It has been alleged that the metal was secured at a cost of about $7 per ton for mining and smelting, but this figure is probably much too low. The ore is silicious, requiring iron or limestone for fluxing. A 125-ton smelter was put in blast Jan. 1, 1901, and blown out in the following November. Mine is 21 miles from a railroad, with a line surveyed but not built. Much trouble has been experienced from shortage of coke supply and inadequate transportation facilities. Operations for 1902 were confined to diamond drill boring. Plans for 1903 unknown.

**COMPANIA MINERA SANTA INEZ Y MORROCOCHA. PERU.**

Office: 19B, Aparacio, Lima, Peru. Mine office: Tuctu, Yauli, Peru. Employs 120 men. Capitalized at 1,200,000 sols. Roberto Pflucker, president; Leopoldo Pflucker, vice-president; Vicente Pazos y Sacio, general manager; Delfin Severo, mining captain. Lands, 20 patented claims, area 40 hectares, with 56 kilometres of miscellaneous lands, in the Morrococha district of Yauli, Peru. Company operates the San Francisco mine, opened on a fissure vein 3′ to 10′ wide and 700′ long, giving average returns of 16% copper and 16 oz. silver per ton from sulpho-arsenide ores of copper. Is developed by three main tunnels, with about 3,000 metres of underground openings, having about 40,000 tons of ore in sight and 25,000 tons blocked out for stoping. Has no mill or smelter, and is worked by hand power, but is installing a 40-kilowatt Siemens & Halske generator and will operate the mine by electricity Mine is served by the Ferrocaril Central, and product is shipped to England for smelting, the monthly output averaging about 200 tons of ore carrying 26% copper. For 1903, company will drive a crosscut tunnel of 500 metres, install 5 electric drills and build and equip a 25-ton concentrator.

**SANTA RITA MINING CO. NEW MEXICO.**

Office: 85 Ames Bldg., Boston, Mass. Mine office: Santa Rita, Grant Co., N. M. A. C. Burrage, president; C. D. Burrage, secretary; B. B. Thayer, superintendent. Lands, 46 patented and 33 unpatented claims, near Santa Rita, Grant Co., showing rich carbonate and oxide ores near surface. Property has an area of about 1 mile square, partially developed, and a portion of the ground is under lease. Has a 90-ton concentrator.

**SANTA ISABEL MINING & SMELTING CO. COLORADO.**

Mine office: Crestone, Saguache Co., Colo. Geo. H. Johnston, superintendent. Has a 60-stamp mill and secures a little copper as a by-product from gold-copper ores.

**SANTA MARIA MINE. HONDURAS.**

At Comayagua, Honduras. Said to be a mountain of copper 10 miles in circumference, averaging 10% to 75% from samples secured at various points. Size of the deposit and value of ore would probably shrink remarkably under the test of actual mining, but property is probably worthy of investigation.

**SANTA ROSA COPPER CO.** **ARIZONA.**

Office: Clifton, Ariz. Mine office: Metcalf, Graham Co., Ariz. Capitalized at $500,000. Jos. A. Tanner, president; L. S. Randolph, secretary. Was working a small force at last accounts.

**SANTA ROSALIA MINING CO.** **MEXICO.**

Supposed to be operating in the Arispe district of Sonora, Mexico.

**SANTIAGO MINE.** **MEXICO.**

At Fuerte, Sinaloa, Mex. D. H. Snyder & Co., owners; Geo. Jennings, manager. Has copper-silver ores, developed by shaft. Was working about 20 men at last accounts.

**SAPHO MINING CO.** **NEVADA.**

Mine office: Ely, White Pine Co., Nev. F. E. Wilson, superintendent. Is opening copper-gold ores by shaft and has steam power, with small force of men.

**SAUK RIVER MINING CO.** **WASHINGTON.**

Office: 327 Pacific Blk., Seattle, Wash. Mine office: Darrington, Snohomish Co., Wash. Organized 1898, under laws of Washington, with capitalization $200,000, shares 50 cents par. Harold G. Price, president and treasurer; Edw. M. Dickson, vice-president; Wm. Van Waters, secretary. Lands, 9 claims, area 180 acres, near Darrington, Snohomish Co., in 3 groups, carrying 3 veins of auriferous and argentiferous copper ore. Vein at Blue Bird group said to be 98′ wide, between porphyry and slate, carrying three pay streaks, of 2′, 4′ and 6′, balance of vein being a low-grade concentrating ore. Ore is self-fluxing and gives good assay values.

**SAUK'S HEAD COPPER MINING CO., LTD.** **MICHIGAN.**

Office: Detroit, Mich. Mine office: Marquette, Marquette Co., Mich. Mining property in Sauk's Head district, northwest of Marquette. Assays give 2% to 3% copper, 2 to 3 oz. silver, and upwards of $100 per ton gold. C. A. Stringer, president; F. M. Moore, vice-president; Chas. H. Krieg, treasurer; John D. Krieg, secretary. Capitalized at $2,500,000, shares $1 par, non-assessable.

**SAULT PROSPECTING & DEVELOPMENT CO.** **ONTARIO.**

Office: Sault Ste. Marie, Mich. R. N. Adams, secretary. Is prospecting a quartz vein carrying chalcopyrite, about 25 miles north of the Bruce mines, in concessions 4 and 5, Morin Twp., Algoma, Ontario.

**SAULT GRAY COPPER CO.** **ONTARIO.**

Has turned over its principal mining property to the Copper Queen Mining Co., of Ontario.

**SAVAGE COPPER CO.** **WYOMING.**

Supposed to have copper claims in Carbon Co., Wyo., but letter addressed to Encampment, Wyo., returned unclaimed, November, 1902.

**SAVAGE GOLD & COPPER MINING CO.**

Address: care of T. H. Thomas, lessee, Cripple Creek, Colo. No returns secured.

**SAYLER MINE.** **CALIFORNIA.**

At Garlock, Kern Co., Cal. N. N. Sayler, owner. Was opening copper-gold ores by shaft and tunnel, with small force, at last accounts.

**SCHUYLKILL COPPER CO.** **ARIZONA.**

Supposed to have property in the neighborhood of Chloride, Mohave Co., Arizona.

**SCOTIA MINING & MILLING CO.** **WASHINGTON.**

Mine office: Bossburg, Stevens Co., Wash. Chas. E. Hoffman, superintendent. Was opening a gold-silver-copper ore body by shaft and tunnel, with steam power and small force, at last accounts.

**SCOTTISH COPPER MINES SYNDICATE OF BRITISH COLUMBIA, LTD.** **BRITISH COLUMBIA.**

Offices: 26, Frederick St., Edinburgh, Scotland. D. Purves, chairman; F. J. Norie, secretary; Henry Croft, manager, Victoria, B. C. Capital, nominal, £25,000. Mining property is in neighborhood of Kamloops, B. C.

**SEABOARD COPPER CO.**

Incorporated July, 1902, under laws of New Jersey, with capitalization $300,000, shares $1 par, $1,000 paid in. Registered office is with New Jersey Registration & Trust Co., East Orange, N. J. No returns secured.

**SEAL BAY MINE.** **NEWFOUNDLAND.**

An old property in Newfoundland, 120′ deep, unwatered in 1900, but presumably idle at present.

**SEARCHLIGHT COPPER-GOLD MINING CO.** **NEVADA.**

Office: 250 Wilcox Bldg., Los Angeles, Cal. Mine office: Searchlight, Lincoln Co., Nev. J. W. Calkins, president; H. C. Norris, vice-president; J. J. Lonergan, secretary; Albert C. Calkins, treasurer; Chas. Van Ina, manager. Said to have a vein 5′ to 7′ wide and 4,000′ long, assaying 10% copper and $20 and upwards in gold per ton. A carload of ore shipped to Los Angeles in 1902 gave returns of better than $50 per ton gold.

**SEATTLE GOLD & COPPER MINING CO.**

Address: care of A. E. Ripley, Seattle, Wash. No returns secured.

**SECURES MINE.** **MEXICO.**

At La Cananea, Sonora, Mexico. Said to be under control of Phelps, Dodge & Co., 99 John St., New York.

**SEDALIA COPPER CO.** **COLORADO.**

Had a mine 7 miles from Salida, Colo. Letter to former office in Denver returned undelivered, October, 1902. Present office, probably Boston. Property idle at last accounts, but is to be reopened by another company.

**SEMINOLE MINING CO.** **GEORGIA.**

Address: care of Wiley, Mitchell & Co., 25 Broad St., New York. Mine office: Washington, Wilkes Co., Ga. Capitalization $1,000,000, shares $1 par. Capt. W. Murdock Wiley, president; Carl Henrich, general manager. Lands, 901 acres, in Wilkes Co., Ga., well timbered with pine, cedar and hardwood, the tract including the old Magruder mine. Development and equipment to close of 1902 have required expenditures of about $125,000. Company is understood to have made small net earnings, before building its smelter, from ores shipped to the Balbach smelter at Newark, N. J., these giving returns of 7.3% copper, 32% lead, $4 gold and $8.40 silver per ton. The ores are auriferous and argentiferous pyrite, chalcopyrite and galena, in a quartz gangue. Tract shows 6 parallel veins, traceable for 800′ and giving evidences of probable persistence to good depths. Main shaft is about 300′ deep and considerable ore has been blocked out for stoping.

The property has a good surface plant including boilers, hoists and other mining machinery. A tram line runs from the mine to the top of the concentrator. The smelter has a 70-ton furnace and was blown in August, 1902, product being turned out as matte. The property is served by a branch of the Georgia Central Railway. This is the only copper mine of any importance in Georgia, and is regarded as of considerable promise.

**SENECA MINE. MICHIGAN.**

A tract of 1,888 acres, just north of the Mohawk and Ahmeek properties, Keweenaw county, Mich. Property undoubtedly carries the underlay of the valuable Kearsage lode. Fully described in the 1902 edition.

**SEVILLA SULPHUR & COPPER CO., LTD. SPAIN.**

Spanish office: Patio de Banderas 4, Sevilla, Spain. Company is a Scotch corporation. John McDougall, manager. Property includes the Cuchichon and adjoining mines, at Almonaster, Huelva, also sundry properties at Aznalcollar, Sevilla, Spain. Mines produce cupriferous iron pyrite, and a considerable output of copper is secured annually by working the cinder after the ore is burned for sulphur. Mines probably produce about 3,000,000 lbs. of copper yearly.

**SEYMOUR COPPER MINING CO., LTD. BRITISH COLUMBIA.**

Offices: 41, John Dalton St., Manchester, Eng. Organized 1900, with capitalization £2,000, to acquire copper properties at Seymour Narrows, Vancouver Island, B. C. No returns secured.

**SHAH OF PERSIA MINE. COLORADO.**

In the vicinity of Crestone, Saguache Co., Colo. Supposed to be owned by Ryan & Allen. Letters returned unclaimed, October, 1902.

**SHANNON COPPER CO. ARIZONA.**

Office: Delta Bldg., Postoffice Sq., Boston, Mass. Mine office: Clifton, Graham Co., Ariz. Employs 300 men. Organized 1899, under laws of Delaware, with capitalization $3,000,000, shares $1 par. Has outstanding bonds of $600,000. Edwin A. Carter, president; John F. Alvord, vice-president; J. Erskine, Jr., secretary; Jas. W. Hazen, treasurer; John A. Church, consulting engineer; preceding officers, W. B. Thompson, Geo. C. Gill, Leonard Wheeler and Chas. Kimberly, directors; Henry S. Anderson, general manager; Wm. Carkeek, mill superintendent; Wm. T. Climo, mining captain.

Lands, 40 claims, 7 patented, area 800 acres, also 400-acre smelter site in the Greenlee district of Graham Co. showing oxide and carbonate ores averaging about 4.5% copper in the upper levels, and sulphide ores averaging about 7% copper in the lower workings. The Shannon company has an agreement with the Arizona Copper Co. regarding side lines, by which the possibility of future litigation is removed, all extralateral rights being mutually waived. The mine is opened by shafts and tunnels that had an aggregate length of 25,406′ on Nov. 13, 1902. Ore bodies are large and development shows about 1,000,000 tons of concentrating ore in sight. All ore can be removed by tunnels to a depth of 1,100′ from the crest of the mountain. Ore is taken from the mine to the railroad by a 1,400′ gravity tram line. The concentrator is to have 500 tons daily capacity and the first section of 250 tons is nearing completion. This is located on the San Francisco river, with ample water supply, 8 miles from the mine, and has crusher, rolls, Huntington mills, jigs and Frue vanners. The concentrator is of steel, on stone foundations. The Shannon has good rail connections and favorable freight rates.

The smelter, at Clifton, 7 miles from the mine, has two 250-ton furnaces, turning out 55% matte. This cannot be worked to anything like its full capacity until the completion of the concentrator. A briquetting plant is to be added to handle flue dust. The smelter was blown in May 5, 1902, and went out of blast September 26, 1902, to await completion of the concentrator. Production for 1902 was 2,068,000 lbs. and 1903 output is estimated by the company at 12,000,000 lbs. The ore is self-fluxing and slag losses for the 15 weeks that the smelter was in commission were 2%, which is entirely too high, and doubtless will be greatly reduced when the smelter is in permanent operation. The cost of production for 1902 was about 10 cents per lb., which should be reduced to about 8 to 8½ cents per lb. when mine, concentrator and smelter are in full and harmonious running order. The 250-ton section of the concentrator will be completed early in 1903 and the equipment of the second section will then begin.

For the year ending August 31, 1902, receipts of the company were $285,041.54, cash and copper, with accounts payable of $21,537.06. The statement of March 31, 1902 showed $335,491 cash on hand.

The Shannon has met with many discouraging delays. The management has worked faithfully in overcoming the various obstacles as presented, and early in 1903 should begin the production of copper upon a sufficient scale to permit fair net earnings, after the payment of all operating expenses and fixed charges.

**SHASTA COPPER MINING CO. CALIFORNIA.**

Property supposed to be near Shasta, Shasta Co., Cal. No returns secured.

**SHASTA GOLD & COPPER CO. CALIFORNIA.**

Office: 326 Post St., San Francisco, Cal. Capitalized at $500,000, shares $1 par. I. M. Wiley, president; W. E. Von Johannsen, secretary; W. F. Mitchell, manager. Lands, 14 claims, in the Dog Creek district of Shasta Co., Cal. Advertises "full particulars and prospectus on request," but has furnished no information for this work in response to repeated requests.

**SHASTA MAY BLOSSOM COPPER MINING & SMELTING CO.** **CALIFORNIA.**

Office: 713 Market St., San Francisco, Cal. Mine office: Winthrop, (Delamar) Shasta Co., Cal. Capitalized at $1,500,000, shares $1 par. Morton Lindley, president and general manager; Lucius A. Booth, vice-president; S. Peter, secretary. Lands, about 200 acres, in the Pittsburg district of Shasta Co., showing 5 fissure veins, of which the principal is 5′ to 30′, with walls of porphyry and schist, carrying low-grade and slightly auriferous iron-copper sulphides in a spar gangue. Is developing by tunnel to strike vein under a 70′ gossan capping. Has about 1,300′ of underground openings. Property shows the same general geological conditions as on Bully Hill, which is adjacent.

**SHAW-GIBSON MINING CO.** **NEW MEXICO.**

Was opening a property near Lordsburg, Grant Co., N. M., by shafts, at last accounts. No returns secured.

**SHAWMUT MINING CO.** **UTAH.**

Office: Boston, Mass. Mine office: Bingham Canyon, Salt Lake Co., Utah. W. B. Andrew, manager. Company made an ineffectual attempt at reorganization in May, 1902.

**SHEEP MOUNTAIN MINING & TUNNEL CO.** **COLORADO.**

Address given as Crystal, Gunnison Co., Colo., but letters to that address returned unclaimed, October and November, 1902.

**SHELDEN & COLUMBIAN MINE.** **MICHIGAN.**

Address: care of J. H. Rice, et al, owners, Houghton, Mich. Property is at Houghton, carrying the northern extension of the Isle Royale and Portage amygdaloids of the Isle Royale mine. Has produced 703 tons, 724 lbs. of copper, and was noted for the profusion of silver associated with copper. Idle since circa 1870.

**SHOSOHNE MINE.** **NEW MEXICO.**

At Amizett, Taos Co., N. M. Gusdorf Bros., owners. Has a 10-stamp mill, working on gold-copper ores, with water power and small force.

**SIBILSKY-CHAPMAN TRACT.** **MICHIGAN.**

Near Calumet, Mich., in 4–57–31, Keweenaw Co., Mich. Exploratory work for Kearsarge amygdaloid lode was begun in fall of 1902, with rather promising results.

**SIERRA-ALTO COPPER MINING CO.** **ARIZONA,**

Office: 60 State St., Boston, Mass. Capitalization $3,000,000, shares $10 par. Geo. D. Coleman, president; Jas. R. Entwistle, secretary. Lands, 36 claims, on Cram Mountain, Maricopa Co., Ariz. Company advertised that the property "shows large quantities of free smelting ore which will shortly place the company on a dividend paying basis," but neglects to furnish particulars for this work, in response to repeated requests.

**SIERRA MORENA COPPER MINES, LTD.** **SPAIN.**

Offices: 2, Basinghall Ave., London, E. C., Eng. E. T. Evans, chairman; R. Stanton, mine manager; J. E. J. Hadath, secretary. Capital, nominal, £80,000; issued, £60,007. Property consists of La Preciosa and adjacent mines, near Penaflor, Sevilla, Spain.

**SIERRA NEVADA MINES. SPAIN.**

Owned by a Belgian company. Mines, having copper-silver ores, are at Guejar Sierra, Granada, Spain. No returns secured.

**SIERRECILLA DEL TAMUJOSO MINES. SPAIN.**

Near Puebla de Guzman, Huelva, Spain. Are government concessions, now owned by C. & J. Sundheim. Some shipments of ore were made by a former company, but ore is complex and requires special treatment. Nothing important being done at present. In charge of Wm. Guthrie Bowie, Alosno, Huelva, Spain.

**SIERRITA MINING & MILLING CO. ARIZONA.**

Office: Tucson, Ariz. Gerrit B. Linderman, president; J. P. Owen, general manager. No returns secured.

**SILVER BAR COPPER MINING CO. NEW MEXICO.**

Address: care of D. P. Sill, president, Colorado Springs, Colo. Letter to mine office at Cooney, Socorro Co., N. M., returned unclaimed, December, 1902. Organized 1899, with capitalization $9,000, shares $1 par. Lands, 80 acres, opened by tunnels of 400′ and 900′, showing ore body 5′ to 10′ wide giving good assay values in copper and silver. Has mill with 5 gravity stamps, Wilfley and Bartlett tables. No returns secured for 1902, and mine probably idle.

**SILVER BELL COPPER CO. ARIZONA.**

Office: Tucson, Ariz. Mine at Red Rock, Pinal Co., Ariz. Idle. Organized under laws of Arizona, with capitalization $25,000, shares $25 par. Company is operated as a close corporation. J. N. Curtis, president and general manager; Albert Steinfeld, vice-president; Ralph K. Shelton, secretary. Lands, 48 unpatented claims, area about 900 acres, in the Silver Bell district of Pima Co., Arizona, carrying fissures in granite, veins being very wide with carbonate ores on surface and chalcopyrite below, latter assaying 9% copper and 3 oz. silver per ton, with occasional lead and zinc and a trace of gold. Has some 50 shafts, mostly shallow; principal shaft, 450′, also several tunnels. Has steam power and 100-ton smelter 1¼ miles distant from mine. Product is turned out as 50% matte. Nearest railroad, 15 miles. New work contemplated for 1903 includes complete equipment at mines for treating 500 tons of ore daily; building a narrow gauge railroad to connect with the Southern Pacific, and erection of a new smelter of 500 tons daily capacity. Property has been idle since February, 1902, awaiting new equipment.

**SILVER CLIFF GOLD & COPPER MINING CO. IDAHO.**

Supposed to have property 2 miles northwest of the Leslie mines, near Saltese, Idaho, but three letters to company and sundry alleged officers returned unclaimed, October and December, 1902.

**SILVER FLAT MINING & MILLING CO. UTAH.**

Organized November, 1902, by Abel John Evans of Lehi, Utah, with capitalization $50,000, shares 10 cents par. Lands, 5 claims, in the American

Fork Canon, Silver Lake mining district, carrying auriferous and argentiferous copper and lead ores.

**SILVER LAKE MINE. COLORADO.**

At Silverton, San Juan Co., Colo. Owned by Guggenheim Exploration Co. S. I. Hallett, manager. Has 400-ton concentrator, steam and electric power and employs several hundred men, securing a small amount of copper as a by-product.

**SILVER SPUR MINING CO. AUSTRALIA.**

Office and mines: Silver Spur, Stanthorpe, Queensland, Australia. Employs 46 men. Organized 1898, under laws of Queensland, with capitalization £24,000, shares £1 par, 15s paid in. Has paid dividends of £18,300. Edgar Hall, secretary and general manager; Robert T. Vyner, G. W. Dight, Edgar Hall, Arthur Orton and Jas. Raff, directors; Richard Prout, mining captain. Lands, 45 acres, in the Stanthorpe district of Queensland, showing 4 lenses averaging 8′ width and 100′ length, with varying depths, carrying sulphide ores returning 1% copper, 12% lead, 20% zinc, $1 gold and 25 oz. silver per ton. Has 4 shafts, deepest 300′, with 12,000 tons of ore blocked out for stoping. Has steam plant, including hoist, 5-drill air compressor, crusher, Chilean mill, etc., also has sawmill and is exploring with diamond drill. Smelter, at the mine, receives ore by tram line and has a 42x100″ water-jacket lead smelter, Austin pyritic smelter and reverberatory furnaces. Product is turned out as 33% matte. Copper production for 1902 was 78,000 lbs. Company has paid dividends of £18,300.*

**SIMILKAMEEN COPPER MINES. BRITISH COLUMBIA.**

Address of company not secured. Stewart Armour, president. Property is in the Similkameen district of British Columbia.

**SIMSBURY MINES. CONNECTICUT.**

At Granby, Conn. Now idle. Once produced carbonate and sulphide ores, to a limited extent only.

**SISKIYOU GOLD & COPPER CO. CALIFORNIA.**

Office: 326 Post St., San Francisco, Cal. Mine office: Rollins, Siskiyou Co., Cal. Lands, 8 claims, area 160 acres, on the stage road between Yreka and Rollins, Siskiyou Co.

**SISKIYOU GOLD & COPPER MINING CO.**

Office: 44 Central Blk., Salt Lake City, Utah. No returns secured.

**SISKOWIT MINE. MICHIGAN.**

Operated 1845-1855, near Rock Harbor, Isle Royale, Michigan, on a 5′ amygdaloid carrying sheet copper in contact with walls. Made about 150 tons copper; main shaft, about 500′.

**SISSON MINE. CALIFORNIA.**

In Shasta Co., Cal. Supposed to be bonded to an English syndicate. No returns secured.

**LA SIVERIA MINE. MEXICO.**

At Topia, Durango, Mex. E. Torres, owner. Is developed by tunnels, Employed about 75 men at last accounts.

**SKOVVASFJELDETS AKTIEBOLAG. NORWAY.**

A small producer of copper at Harran, Norway. N. Tiskum, manager. No returns secured.

**SKYLARK COPPER MINING & MILLING CO.**

Office: 40 Commercial Blk., Salt Lake City, Utah. Location of company's property, if any, unknown.

**SLATE CREEK MINING & MILLING CO. WYOMING.**

Office: Wheatland, Wyo. M. F. Montgomery, superintendent. No returns secured.

**SLATER COPPER MINES CO. MISSOURI.**

Office: Willow Springs, Mo. Did a little exploratory work in Shannon Co., Missouri, in 1901.

**SMOKEHOUSE MINING CO. MONTANA.**

Office and mine: Butte, Silver Bow Co., Mont. Bernard Noon, general manager. Has a two-compartment main shaft about 500′ deep. Was employing a small force on development work at last accounts.

**SNOHOMISH & TRAMWAY MINES. MONTANA.**

At Butte, Silver Bow Co., Mont. Half interest owned by F. A. Heinze, other half in dispute between Clara Larkin and Amalgamated Copper Co. A limited producer with a large bank account in the hands of a receiver.

**SNOWBIRD MINE. MONTANA.**

At Butte, Silver Bow Co., Mont. In dispute between the Montana Ore Purchasing Co. and the Anaconda Copper Co.

**SNOWSHOE GOLD & COPPER MINES, LTD. BRITISH COLUMBIA.**

Offices: 7, Poultry, London, E. C., Eng. Mine office: Phoenix, B. C. Employs 50 men. Organized 1901, with capitalization £250,000, shares £1 par, non-assessable. Earl of Chesterfield, chairman; Geo. S. Waterlow, D. L., J. P., vice-chairman; Thos. J. Morris, secretary; Anthony J. McMillan, managing director; preceding officers, Chas. Guy Pym, M. P. and Lewis H. Jones, M. D., directors; J. W. Astley, superintendent; J. H. Trevorrow, mining captain. Lands, 4 patented claims, area 120 acres, in the Yale & Cariboo district. Company is developing a fissure replacement, running 25′ to 200′ wide and 1,000′ long, carrying chalcopyrite. Has shafts of 200 and 300′ and tunnels of 250′, 200′ and 600′, with about 7,000′ of underground openings, and about 500,000 tons of ore in sight. Has a fine mining equipment, including a 30-drill Rand-Corliss cross-compound condensing steam and compound air compressor; 150-h. p. double conical electric hoist, also smaller hoists, pumps, drills, etc. Canadian Pacific railway runs through property and carries ore to smelters at Boundary Falls and Greenwood. Matter of building a smelter is under consideration by company. Output for 1902 was about 15,000 tons of ore. Output will be increased to 400 tons daily at beginning of 1903. Bulk of production comes from open-cast workings.

**SNOWSTORM MINE. IDAHO.**

Near Saltese, Idaho, in the Coeur d'Alene district. Said to have a 40′ vein of leaching ore; was bonded to Jos. Greenough at last accounts.

**SOCORRO GOLD MINING CO. ARIZONA.**

Mine office: Harrisburg, Yuma Co., Ariz. J. Wetherley, manager. Gold-silver-copper ores are being developed by shafts. Has steam power and employed a small force at last accounts.

**SOLACE MINING CO. ARIZONA.**

Incorporated October, 1902, with capitalization $500,000, by Ignatius Schlinger and N. P. Morey, to develop 5 claims near the Bloody Tank mine, 8 miles from Globe, Gila Co., Arizona.

**SOLOMON SPRINGS COPPER MINING CO. ARIZONA.**

Mine office: Naco, Bisbee Co., Ariz. H. C. H. Palmer, superintendent. Lands, 20 claims, area 400 acres, in the Naco valley, near Bisbee. Has 2 shafts, deepest 200′. Veins show gossan cappings of 4′ to 40′.

**SONOMA MINES OF MEXICO, LTD. MEXICO.**

Offices: 4, Great Winchester St., London, E. C., Eng. Mine office: Avino, Durango, Mexico. Capitalization £500,000, shares, £1 par, non-assessable. Lands, 410 acres. C. B. Flinn, managing director; Geo. H. Johnson, secretary; E. L. Wagner, superintendent.

**SONORA COPPER CO. OF MEXICO. MEXICO.**

Office: probably New York. Company's affairs apparently in a complicated condition, but no statement received from officers. Company was formed to fight W. C. Greene, and has some sort of claim against the Cobre Grande company, which sold its property to La Cananea Consolidated Copper Co., which in turn sold to the Greene Consolidated Copper company. Assets of the Sonora Copper Co. of Mexico said to have been transferred to the Puertecito Copper Co.

**SONORA DEVELOPMENT CO. MEXICO.**

Office: 603 New Ridge Bldg., Kansas City, Mo. Organized under laws of Arizona, with capitalization $1,000,000. Wm. Huttig, president; Alfred Blaker, vice-president; Wm. A. Rule, treasurer; John W. Amerman, secretary; Geo. F. Woodward, general manager. Company declines to furnish specific returns. Property at last accounts was 98 claims in the Moctezuma district of Sonora, Mexico and included the Don Genaro y Anexas, Goodlander, Santa Clara, Nacozari Copper Queen, Wostenholm, Conforne, Cuahtumoc and La Verde mining groups. The Nacozari Copper Queen lies between the Pilares de Nacosari and Belle Union mines of the Moctezuma Copper Co. This property has 26 claims and produces ore assaying as high as 58% copper. Company will build an extensive plant on the Wostenholm tract, which is near the terminus of the Nacozari Railway. Property is well spoken of and officers are men of good standing.

**SONORA MINING & MILLING CO. MEXICO.**

Mine office: Tubutama, Sonora, Mexico. Is in the Altar district of Sonora, Mex. Con. O'Keefe, manager. Property is extensively opened by shafts and equipped with steam power and leaching plant. Is said to have a very large deposit of low-grade argentferous copper ore, and to be working a considerable force of men.

**COMPANHIA MINEIRA DE SOTIEL-CORONADA. SPAIN.**

Office: Lisbon, Portugal. Mine office: Calañas, Huelva, Spain. Lands, 6,666 hectares, near Calañas, including 34 openings. Production was 795 long tons refined copper in 1899.

**SOCIEDAD ANONIMA MINAS DE SOTO. SPAIN.**

Office: Bilbao, Spain. Mine office: Reinosa, Santander, Spain. Company was doing development work only at last accounts.

**SOUTH AFRICAN CHARTERED CO. RHODESIA.**

This company, or some subsidiary corporation, is doing a large amount of development work at the Victoria Falls of the Zambesi river. A large electric power plant is to be installed under the direction of Sir Douglass Fox and Sir Chas. Metcalf as consulting engineers.

**SOUTH AFRICAN EXPLORATION SYNDICATE. CAPE COLONY.**

Has copper properties in Namaqualand, Cape Colony. No returns secured.

**SOUTH AMERICAN DEVELOPMENT CO. PERU.**

Organized to buy and operate the mines of Cerro de Pasco; has been succeeded by the Cerro de Pasco Mining Co.

**SOUTH AUSTRALIAN COPPER SYNDICATE, LTD. AUSTRALIA.**

Office: 13, St. Helen's Pl., London, E. C., Eng. Secretary writes that company is not doing and never has done any business.

**SOUTH BISBEE COPPER MINING & TOWNSITE IMPROVEMENT CO. ARIZONA.**

Office: 104 Stimson Blk., Los Angeles, Cal. Property, at Bisbee, Ariz., was sold to the Lake Superior & Pittsburg Development Co. in 1902. Shareholders were wrangling over the division of proceeds of sale at last accounts.

**SOUTH KEARSAGE MINE. MICHIGAN.**

Owned and operated by the Osceola Consolidated Mining Co.

**SOUTH MT. LYELL MINING CO., LTD. TASMANIA.**

Offices: Queen St., Melbourne, Australia, and 153-155, Leadenhall St., London, E. C., Eng. Organized 1896, under laws of Victoria, with capitalization £600,000, shares £2 par, non-assessable. Geo. Moore, acting chairman; Nicholas Madden, secretary, Melbourne; H. M. Taylor, acting secretary, London. Work has just been resumed on the property, which is 93 acres, in the Mt. Lyell field of Tasmania. Ore is sulphide. Main shaft, 718'; No. 2 shaft 90'; center tunnel, 703'; main tunnel, in Darwin section, 270'. Company is now selling ore to the North Mt. Lyell Copper Co., Ltd.

**SOUTH PEACOCK MINING CO. IDAHO.**

Office: 88 State St., Boston, Mass. Mine office: Weiser, Washington Co., Idaho. Capitalization $500,000. Thos. S. Wentworth, president; Wm. L. Pratt, secretary. Lands are in the Seven Devils district of Idaho. No returns secured and property supposed to be idle.

**SOUTH RANGE MINING CO. MICHIGAN.**

Office: Houghton, Mich. R. R. Goodell, president; F. W. Nichols, secretary. Owns 4,000 acres of mineral land in 9 tracts of 80 to 480 acres each, between the Globe and Belt properties, in Houghton and Ontonagon counties, Michigan.

**SOUTH SIDE MINING CO.** **MICHIGAN.**

Address: care of John C. Watson, 68 Devonshire St., Boston, Mass. Property is a tract of nearly 200 acres at Houghton, Houghton Co., Mich., lying just west of the Dacotah and north of the Naumkeag, with a half-mile frontage on Portage Lake.

**SOUTH THARSIS MINE.** **TASMANIA.**

Mine office: Gormanston, Montague Co., Tasmania. Was opened 1898 and is about 350′ deep. Estimated 1900 output was 150 tons copper.

**SOUTHWESTERN COPPER & IRON CO.** **NEW MEXICO.**

Was working, circa 1900, near Santa Rita, Grant Co., N. M. No returns secured.

**SOUTHERN ZINC & COPPER CO.** **ARKANSAS.**

Office: Waterloo, Iowa. Is developing zinc properties only, at Gillham Ark. Maj. L. E. Baker, general manager.

**SOVEREIGN COPPER MINING CO.** **WYOMING.**

Supposed to have copper property in vicinity of Battle, Carbon Co., Wyoming.

**SOWELL MINE.** **OREGON.**

At Althouse, Josephine Co., Ore. J. Sowell & Co., owners. Was developing by tunnel, with small force, at last accounts.

**SPANISH COPPER CO., LTD.** **SPAIN.**

Offices: 2, Tokenhouse Bldgs., London, E. C., Eng. C. A. De Mancha, chairman. Capital, nominal, £150,000. Property comprises various sulphur and copper mines in the province of Huelva, Spain, held on lease in perpetuity at annual rental of £400. No returns secured and company thought not to be operating.

**SPANISH MINERALS DEVELOPMENT.** **SPAIN.**

Offices: 151, Cannon St., London, E. C., Eng. J. B. White, chairman; A. Thomas, mine manager; W. E. Hopper, secretary. Capital, nominal, £100,000. Lands, about 476 acres, include the Esperanza, Forzcsa and other mines in the vicinity of Almonaster, Huelva, Spain. Development work only was in progress at last accounts.

**SPARONE MINES.** **ITALY.**

A group of small producers in Piedemont, Italy.

**SPECULATOR MINING CO.** **MONTANA.**

Office and mine: Butte, Silver Bow Co., Mont. John A. Creighton, president; John Dougherty, secretary and general manager. This is the most important independent property in the Butte camp, but notwithstanding its independence of all entangling alliances is also a victim of litigation, which caused the suspension of operations in 1902. Employs about 300 men when working. Main shaft has 3 compartments and is about 1,400′ deep. Has an excellent surface plant and is connected underground with the High Ore mine.

**SPENCE CLAIMS.** **OREGON.**

J. Spence & Co., owners, Althouse, Josephine Co., Ore. Tunnel was being driven with small force at last accounts.

**SPENCE MINERAL CO.** **CALIFORNIA.**

Office: San Francisco, Cal. Mine office: Spenceville, Nevada Co., Cal. Chas. W. Howard, general manager. Is one of the oldest mines in the state and has been working almost continuously since 1875, though never on a large scale. Ore occurs in wide, irregular fissures, near the contact of diorite and grano-diorite. Ore is sulphide, carrying gold and silver. Mine has yielded about 150,000 tons of ore, running 2% to 20% and averaging about 5% copper. Output has been mainly as cement copper. Present owners are using pyritic smelting, making acid from the sulphur and leaching the copper from the residue of burned ore.

**SPONDULIX MINE.** **COLORADO.**

At Granite, Chaffee Co., Colo. A. D. Bullis, owner; B. H. Pelton, superintendent. Is opening gold-silver-copper ores by shaft.

**SPRINGDALE COPPER MINING CO.** **OREGON.**

Mine office: Athena, Umatilla Co., Ore. Was driving a tunnel at last accounts.

**SPRINGFIELD GOLD & COPPER MINING CO., LTD.** **IDAHO.**

Office: 720 Bank St., Wallace, Shoshone Co., Idaho. Capitalization, $100,000, shares 10 cents par. William Lively, president; D. A. McKenzie, vice-president; Jos. T. Whelan, secretary; E. Zeitfuchs, treasurer. Lands, 4 patented claims, area 80 acres, in the St. Joe district of Shoshone county, Idaho. Two fissure veins are being opened, these showing estimated average value of $22 per ton. Has 3 tunnels, longest 860′. Development work to be continued during 1903.

**SPRINGFIELD MINE.** **MARYLAND.**

An old property in Carroll Co., Md. Formerly a small producer, but idle for many years.

**STANDARD COPPER MINE.** **ARIZONA.**

Offices: Swan House, Copthall Ave., London, E. C., Eng. Mine office: Clifton, Graham Co., Ariz. London agent, C. A. Dodge. Col. D. C. Casey, superintendent. Organized under laws of Arizona with capitalization $500,000, shares $1 par. Lands, 105 acres, near Clifton, Graham Co.

**STANDARD GOLD & COPPER MINING CO.** **OREGON.**

Mine office: John Day, Grant Co., Ore. Z. Houser, superintendent. Has gold-copper ores, opened by tunnel with steam power and small smelter. Employs about 25 men.

**STAR COPPER MINING CO.** **MICHIGAN.**

Owns tracts of 720 acres in Sections 9, 10 and 16, 58-28, between the Clark and Copper Harbor properties, in Keweenaw Co., Mich. Two shafts were sunk and $70,000 expended in exploratory work, 1851-1857. Company reorganized 1887 under present title.

**STARLIGHT MINE. ARIZONA.**

Near San Carlos, Gila Co., Ariz. W. J. Nicholson, superintendent. Was driving tunnel with small force at last accounts.

**STATE LINE COPPER MINING CO. WYOMING.**

Office: 300 Century Bldg., Denver, Colo. Employs 6 men. Organized under laws of Wyoming, with capitalization $75,000, shares 5 cents par. C. B. Ayres, president; Jos. Sampson, vice-president; W. W. Wemott, secretary and treasurer; J. B. Drew, superintendent. Lands, 17 unpatented claims, area 340 acres, in the Upper Platte district of Carbon Co., Wyo., showing 4 fissure veins, of which 2 are being developed, these ranging from 2′ to 40′ in width. Has 17 pits and shafts, of 10′ to 60′ depth. Company intends to sink 2 shafts and drive an 800′ tunnel in 1903.

**STATE OF TEXAS GROUP. ARIZONA.**

A group of claims in the Huachuca Mountains, west of Bisbee, Cochise Co., Ariz., supposed to be bonded to Michigan parties.

**STAUFFER CHEMICAL CO. CALIFORNIA.**

Office: San Francisco, Cal. Property is 80 acres, known as the Alma mine, near Oakland, Alameda Co., Cal., developed mainly by tunnels. Ore bodies occur as lenses in a belt traced 3,000′ between serpentine and metamorphosed chert. Ore is chalcopyrite, ranging 1.5% to 3.5% copper, up to 50% sulphur and about $2.50 gold per ton. After burning for sulphur the cinder is leached for copper.

**STEPHENS CLAIMS. MONTANA.**

Address: W. J. Stephens, owner, Higgins Blk., Missoula, Mont. Lands, about 100 acres, show 3 fissure veins, one 70′ wide, with a smaller vein of smelting ore, the larger vein carrying about 2% copper, with some silver and gold. Has 2 shafts, deepest 149′, also tunnels of 924′ and 528′, and upwards of 2,000′ of underground openings. Shipments to smelter at Butte have returned 12% copper, $4.50 gold and 28 oz. silver per ton.

**STEPHENSON-BENNETT CONSOLIDATED MINING CO. NEW MEXICO.**

Mine office: Organ, Donna Ana Co., N. M. W. H. Mackay, Jr., superintendent. Has silver-lead-copper ores, developed by tunnel and shaft, with steam power and 50-ton concentrator. Employs about 50 men.

**STEPTOE MINING CO. NEVADA.**

Property sold to New York & Nevada Copper Co., Sept. 4, 1902.

**STERLING COPPER CO. ARIZONA.**

Address: care of Geo. H. Rache & Co., 44 Broadway, New York. M. Fraser Bolen, president. Lands, 4 claims, in Graham Co., Ariz., on which about 1,000′ of development has been effected, showing ores of good assay value. No returns secured.

**STEVENS COPPER CO. ARIZONA.**

Mine office: Clifton, Graham Co., Ariz. Chas. E. Stevens, superintendent. Lands are in the vicinity of Metcalf, Graham Co. Was developing by shaft, with small force, at last accounts.

**STEVENS PEAK COPPER MINING CO.** **IDAHO.**

Address: care of A. M. Strode, president and manager, Mullan, Idaho. Company was in financial straits at last accounts. No returns secured.

**STILAGUAMISH & SULTAN MINING CO.** **WASHINGTON.**

Address: care of J. W. Clise, president and general manager, Seattle, Wash. Property is the Little Chief claim, on which about 500′ of development work has been done, also some diamond drill prospecting. Ore is low-grade and slightly auriferous.

**STILLMAN COPPER MINING CO.** **WYOMING.**

Office: 408–145 La Salle St., Chicago, Ill. Lands, in the Encampment district of Carbon Co., Wyoming. No returns secured.

**STOBIE MINING CO.** **ONTARIO.**

Office: Sault Ste. Marie, Ont. Mine office: Desbarats, Algoma, Ont. Organized 1900, under laws of Ontario, with capitalization $1,000,000, shares $1 par. Jas. Stobie, president; A. B. Upton, vice-president and general manager; John Lear, secretary and treasurer. Lands, 134 acres, in Block O, Johnson Twp., Algoma, Ont., showing vein 3′ to 5′ wide, carrying chalcocite, chalcopyrite and bornite. A carload of ore smelted at Dollar Bay, Mich., in 1901, gave net returns of 18% copper. Property supposed to be working, but no returns secured.

**STOCKTON COPPER MINING CO.** **MONTANA.**

Office: 1 W. Broadway, Butte, Mont. Mine office: Radersburg, Broadwater Co., Mont. Organized under laws of Montana, with capitalization $1,000,000. E. W. Harney, president; P. A. Gamer, secretary; John Rathfus, superintendent. Lands include the Idaho claim, in East Butte, and the North Star group, in Broadwater Co., the latter having been a limited producer in the past. Property is considered of value, but company was financially embarrassed at last accounts. No returns secured.

**STODDARD COPPER CO.** **ARIZONA.**

Office and mines: Stoddard, Yavapai Co., Ariz. Capitalization $3,000,000. Isaac T. Stoddard, president; J. C. Carley, secretary; John Martin, superintendent. Lands, several patented claims in the Stoddard district of Yavapai Co., on which about $300,000 have been expended on the mine and plant. Has a concentrator with Huntington mill, also a 40-ton smelter. Considerable quantities of high-grade carbonate and oxide surface ores were succeeded by a zone from which copper values had been leached, but promising sulphides have been secured at depth.

**STONE CREEK MINING & MILLING CO.** **MONTANA.**

Office: 818–109 Randolph St., Chicago, Ill. Mine office: Dillon, Beaverhead Co., Mont. Organized 1901, under laws of Arizona, with capitalization $1,250,000, shares $1 par. G. J. M. Porter, president; Arthur R. Brittan, vice-president; B. J. Soper, secretary; F. M. Crane, treasurer; W. D. Porter, superintendent. Lands, 8 claims, area 125 acres, in Stone Creek district of Madison Co., Mont., showing low-grade copper outcrops, also malachite and azurite, in promising quantities. Has 6 shallow shafts, main shaft of 60′ having 2 compartments, also 130′ tunnel. For 1903 company will continue sinking and add steam power equipment.

**STONE HILL COPPER MINES. ALABAMA.**

At Cleburne, Alabama. Now idle. Were once worked extensively, and had a reduction plant.

**STONEWALL COPPER CO. ARIZONA.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Claims are in Pima Co., Ariz., adjoining the alleged "mines" of the Jack Tar, Plenty and other Wernse swindles, none of which show more than a 20′ hole. See Excelsior Copper Co.

**SANTIAGO STOPELLI. MEXICO.**

Was operating a copper property at Jiminez, Chihuahua, Mexico, at last accounts.

**STORA KOPPARBERG BERSLAGS AKTIEBOLAG, SWEDEN.**

Office, mines and works: Falun, Dalarne, Sweden. Capitalization, 9,600,000 kronor, shares, 1,000 kronor par. E. J. Ljungberg, director; Lars Yngström, assistant director and general manager; Th. Witt, mining engineer; K. A. Akerblom, superintendent of leaching plant. Lands, 5 claims, 3 patented and 2 unpatented, area 43 hectares. The mine was worked A. D. 1288, and very probably some years earlier, the oldest privileges of the present company being dated Feb. 24, 1347. Company is extensively engaged in industrial operations, owning and operating iron and steel plants, paper mill, pulp mill, sawmill, etc., in addition to its copper mines and smelters. The largest ore body is a mammoth lense 370 metres long by 220 metres wide and of about 320 metres depth, much of which has been mined out, leaving a large open pit about 200′ deep. There are also many smaller lenses. The ore is chalcopyrite, containing selenium and bismuth, giving an average return of 2.7% to 3% copper, 2.5 to 3 grams gold and 10 to 15 grams silver per ton. There are 14 shafts, with aggregate depth of 1,800 metres, deepest being 343 metres. There are also about 33 kilometres of tunnels. The copper mine employs about 100 men and gives a yearly production of about 43,000 tons of raw ore, which, after hand-cobbing, yields about 14,000 tons of leaching ore. Hydraulic power is utilized for mining operations. The roasting stalls are one-half kilometer from the mine, with tramline between, and the leaching plant is one-half kilometer beyond the furnaces. The roasted ore is crushed with salt, reroasted and leached in tanks with dilute sulphuric acid, after which the copper in the leach-water is precipitated on scrap iron, the cement copper so secured being dissolved in sulphuric acid and turned out as bluestone. Annual production is about 1,250 tons sulphate of copper, 80 kilograms of gold and 300 kilograms of silver.

**STORRGRUFA MINE. SWEDEN.**

See Stora Kopparberg Berslags Aktiebolag.

**STOWELL COPPER MINE. CALIFORNIA.**

Sometimes known as Webster Consolidated. Has 7 patented and 3 unpatented claims, near Copley, Shasta Co., Cal., with about 600′ of crosscut tunnels. Owned by J. H. Stowell Estate.

**STRATHCONA MINE. ONTARIO.**

Address: care of J. F. Black, owner, Sudbury, Ont. Lands, in Levack township, near Sudbury, Algoma, Ont., show copper-nickel sulphides, which have been slightly developed by shafts. Is valuable, apparently.

**STRICKLEY-MONTEZUMA MINING CO. UTAH.**

Mine office: Bingham Canyon, Salt Lake Co., Utah. W. J. Strickley, superintendent. Has gold-copper ores, opened by shaft and tunnel. Has steam power and employs a small force.

**STRONG MINE. OREGON.**

Address: care of T. W. M. Draper, owner, Waldo, Josephine Co., Ore. Has auriferous copper ores and is equipped with steam power and smelter. Was employing a considerable force at last accounts.

**STRONG COPPER CO. WYOMING.**

Mine office: Laramie, Albany Co., Wyo. I. R. Swigert, manager. Ores carry copper and silver. Was developing by shaft and tunnels at last accounts.

**STRONG COPPER CLAIMS CO.**

See Waldo Smelting & Mining Co.

**SUCCESS COPPER MINING CO. ARIZONA.**

Office: 536 Douglas Bldg., Los Angeles, Cal. Mine office: Quartzite, Yuma Co., Ariz. Employs 12 men. Organized 1902, under laws of Arizona, with capitalization $750,000, shares $1 par. Chas. E. Eichelberger, president; Epes Randolph, vice-president; Robert Marsh, secretary and treasurer; John A. Rivers, superintendent. Lands, 6 unpatented claims, area 124 acres, in the Plomosa district of Yuma Co., showing 5 contact veins, of which 2 are being developed, these having an average width of 12′ and giving average assays of 15% copper, $3 gold and 40 oz. silver per ton, from carbonate and oxide ores. Has shafts of 60′, 75′, 115′ and 250′, also a 300′ tunnel with 1,700′ of underground openings. Installed a steam plant late in 1902. Will sink shaft 600′ in 1903, and is understood to contemplate the installation of a 50-ton smelter.

**SUGAR LOAF GROUP. CALIFORNIA.**

C. D. Galvin, owner. Property is near Copley, Shasta Co., Cal. Said to have a good surface showing. No work in progress.

**SUGAR LOAF MINING CO. SOUTH DAKOTA.**

Is working the Richard Palmer mine, at Spring Creek, near Custer, South Dakota, under bond, and has shipped some copper ore to the Deadwood smelter. Drake, Barnes & Co., Cleveland, Ohio, are said to be the principal owners of the company's shares.

**SULITELMA AKTIEBOLAG. NORWAY.**

Office: Helsingborg, Sweden. Mine office: Sulitjelma, Nordland, Norway. Employs about 1,000 men. Organized 1890, under laws of Sweden, with capitalization 3,000,000 kroner, shares 500 kroner par, fully paid. Lord Lieutenant G. Tornerhjelm, president; Consul Nils Persson, vice-president and general manager; Sture P. Henning, vice-general manager; preceding officers, C. Ingelsson, August Sylvan, Thure Röing, P. M. B. Schjölberg, C. E. Hedström, Prof. Hjalmar Sjögren and E. Knudsen, directors. Lands, about 100,000 acres, in the Skjerstad district of Nordland, including the Sulitelma, Charlotta and Geken groups, showing large bodies of sulphide ore, ranging in tenor from 1.5% to 5%, and averaging about 3.5% copper and 45% sulphur. Property lies north of the Arctic circle and was opened 1890. Production was 396 tons of copper in 1895 and about 1,000 tons in 1899. An adjacent water-power has been developed and the mine has a good machinery equipment. The property is equipped with a modern smelter and converter plant, product being turned out as slightly argentiferous blister copper. Dividends of 10% were paid in 1899 and 1900, and a 6% dividend was paid in 1901.

The ore bodies are extended lenses, very persistent in strike and depth, and are opened by one shaft and a number of tunnels. Present annual production, about 2,000 tons, is shipped as converter bars. Mine also ships about 35,000 tons of pyrites yearly, half fines and half lumps, averaging 5% copper and 45% sulphur, to various sulphur burners in England, Sweden and Russia. Ore is chalcopyrite in iron pyrites, the lenses occurring in micaceous schists of lower Silurian age, which are near eruptive flows of greenstone conformable with the schists. Mines are about 2,000′ above the sea level. The smelter has two 36″ water-jacket blast furnaces of about 35 tons daily capacity each, and one stand of converters.

**SULLIVAN GOLD & COPPER MINING CO. MONTANA.**

Supposed to be operating near Kalispell, Montana.

**SUN-ANCHOR COPPER MINING CO. WYOMING.**

Office: Encampment, Carbon Co., Wyo. L. W. Tennant, superintendent. Was employing a few men in prospecting work at last accounts.

**SUNDOWN MINE. ARIZONA.**

Near Globe, Gila Co., Ariz. L. C. Woods, superintendent. Was driving a tunnel with small force at last accounts.

**SUNNY CORNER SILVER MINING CO. AUSTRALIA.**

In the Sunny Corner division of New South Wales. Secures a little copper as a by-product from the smelting of silver ores, having made 38 tons of copper from 3,814 tons of ore smelted in 1901.

**SUNNYSIDE COPPER MINING CO. WYOMING.**

Property is six miles from Riverside, Carbon Co., Wyo. Was driving a tunnel in November, 1902.

**SUNRISE COPPER CO. WYOMING.**

Organized September, 1902, under laws of Wyoming. O. L. Vincent, president; H. B. Jarrad, secretary; J. D. Gilchrist, treasurer. Property is about 11 miles from Sunrise, Wyo. Copper ores are auriferous and argentiferous.

**SUNSET COPPER CO., LTD. BRITISH COLUMBIA.**

Near Princeton, Yale & Cariboo district, B. C. Has auriferous copper ores, opened by shaft. Has steam power and employs a small force.

**SUNSET COPPER MINING CO. WASHINGTON.**

Office: New York Blk., Seattle, Wash. Mine office: Index, Snohomish Co., Wash. Organized under laws of Washington, with capitalization $2,000,000, shares $1 par. J. A. Soderburg, president and manager; John E. McManus, secretary. Lands, 13 claims, area 260 acres, and four 5-acre millsites also sundry water rights, on Trout Creek, a stream of sufficient size to furnish requisite power for the mine and proposed reduction works. Lands are heavily timbered with white pine, cedar, spruce and fir. Mine has nearly 2,000′ of underground openings, and about $60,000 has been expended in development and equipment. Company has a 6½ mile tramline to Index, giving direct rail communication with smelters, the tramline including a suspension bridge over the Skykomish river near Index. Has shipped 300 tons of ore to the Puget Sound Reduction Company's smelter at Everett, Wash., from which returns of 9% copper were secured, and has 17,000 tons of 6% ore blocked out for stoping. Mine has 3 parallel veins traversing granite, the principal vein ranging 3′ to 16′ in width, with the best percentages of copper in the bulges. The ground stands well, requiring little timbering. Ores are chalcopyrite and bornite, former near surface, latter coming in at depth. The chalcopyrite is auriferous and the bornite argentiferous, ores occurring in a quartz gangue, somewhat decomposed near surface but solid at depth. Mine is opened by main tunnel at an elevation of 1,450′ above sea level. Equipment includes shops, bunk-houses, etc.

**SUNSET GROUP.** **BRITISH COLUMBIA.**

Six full and one fractional claim one mile from Brown's Bay, above Seymour Narrows, Naniamo district, Vancouver, B. C. Chalcopyrite and bornite occur in a quartzose gangue, traversing an amygdaloidal diabase.

**SUPERIOR COPPER CO.** **ARIZONA.**

Office: 20 Broad St., New York. Mine office: Tucson, Pima Co., Ariz. Lands are 26 miles south of Tucson. No returns secured.

**SUPERIOR COPPER CO., LTD.** **ONTARIO.**

Office: Sault Ste. Marie, Ont. Mine office: Superior mine, via Sault Ste. Marie, Ont. Employs 40 men. Organized 1901, under laws of Ontario, with capitalization $1,500,000, shares $10 par, non-assessable. Frank Perry, president; E. G. Fisher, vice-president; Frank M. Perry, secretary, treasurer and superintendent; preceding officers, R. H. Munson, W. G. Martin, F. R. Price, Geo. Kemp, J. P. Moran and H. V. Hanger, directors; P. A. Derry, mining captain. Lands, 8 patented claims, area 680 acres, in the Algoma district of Ontario, showing two fissure veins averaging 30′ to 50′ in width respectively, with 1,000′ uncovered on the smaller and nearly a mile stripped on the larger vein. Ores are chalcopyrite, bornite and chalcocite, with quartz gangue, averaging 6% copper, $1 gold and 2 oz. silver per ton, with considerable native copper imbedded in the sulphide ores. Property is developed by four shafts of 40′, 70′, 100′ and 130′, also two 20′ testpits. Has steam power equipment, including half of a 12-drill Ingersoll-Sergeant air compressor, 5 power drills, two hoisting engines, etc. Nearest railroad is the Algoma Central, 3 miles from mine; road will be built into mine whenever it is desired to begin shipping. Considerable ore of good quality has been stocked at the shafts. Property is vigorously managed and is of considerable promise.

**SUPERIOR COPPER & GOLD MINING CO.**

Office: 64 East Second St., Salt Lake City, Utah. No returns secured.

**SUPERIOR MINING CO. NEW MEXICO.**

Letter addressed to this company returned unclaimed, October, 1902, from Cerillos, Santa Fe Co., N. M.

**SUPERIOR MINING CO. WASHINGTON.**

Office: 1529 Tower Ave., West Superior, Wis. Mine office: Berlin, King Co., Wash. Organized 1902, under laws of Washington, with capitalization $2,000,000, shares $1 par, non-assessable. J. P. Simon, president and treasurer; H. J. McIntosh, vice-president and mining engineer; B. A. Baerlocher, secretary and superintendent. Lands, 4 unpatented claims, area 83 acres, in the Miller River district, King Co., Wash. Development work is under way on a fissure vein 8′ wide, carrying estimated values of 6% copper, 0.04 to 1.5 oz. gold and 7 oz. silver per ton. Ores, sulphide and carbonate, with a little galena. Has a 125′ tunnel. Water power is used. Mine is 4½ miles from Great Northern Ry. New work contemplated for 1903 includes 900′ of tunneling and sundry surface improvements.

**SURE THING COPPER MINING & SMELTING CO. WASHINGTON.**

Properties adjoin the Dutch Miller group, in King Co., Wash. Company owns about 100 claims and considerable preparatory work has been done. Extensive developments are planned for 1903.

**SUSQUEHANNA GOLD MINING CO. BRITISH COLUMBIA.**

Near Hall, Yale & Cariboo district, B. C. F. Elwin, superintendent. Company was doing development work with small force, at last accounts.

**SWAKOPMUND MINING CO. GERMAN SOUTHWEST AFRICA.**

Mine office: Corob, via Swakopmund, German Southwest Africa. Company is developing copper prospects. No returns secured.

**SWALLOW MINE. ARIZONA.**

Letter sent to Briggs, Yavapai Co., Ariz., November, 1902, returned with notation "out of business."

**SWEDEN GROUP. WASHINGTON.**

Eight claims on the north shore of Spirit Lake, 6 miles from Mt. St. Helens, Wash. Paradise vein, 33′ wide, has been traced 3,000′. Ore from a short tunnel assayed 9% copper, $3.25 gold and 6 oz. silver per ton. Owners were developing water power and preparing to ship ore, at last accounts.

**SWIGART-BAKER GROUP. WYOMING.**

A property in Carbon Co., Wyo., showing argentiferous tetrahedrite and chalcocite. No returns secured.

**SWINDLER MINE. ARIZONA.**

At Huron, Yavapai Co., Ariz. Letter returned November, 1902, with notation "not operating." There are, however, plenty of swindlers remaining in the copper business.

**SWISS GIRL MINING CO. ARIZONA.**

Mine office: Dewey, Yavapai Co., Arizona. Jules Baumann, superintendent. Was driving a tunnel at last accounts.

**SYLVANIA MINE. NEVADA.**

Mine office: Bullion, Elko Co., Nev. F. J. Frank, superintendent. Was driving a tunnel with small force at last accounts.

**TABLAS-FINANA COPPER CO., LTD. SPAIN.**

Offices: 106, Fenchurch St., London, E. C., Eng. J. B. Newton, chairman; W. J. Winkley, secretary. Capital, nominal, £150,000; issued, £75,007. Property includes 2 groups of claims, area 942 acres, near Tablas, Granada, and Finana, Almeria, Spain. Only limited development work was in progress at last accounts.

**TABLE MOUNTAIN COPPER CO. ARIZONA.**

Letters to former address, Kelvin, Pima Co., Arizona, returned unclaimed, October and November, 1902. Wallapai Clark, president. Lands, are sundry claims in Pinal Co., and 87½% of the stock issue is owned by the Arimex Consolidated Copper Co.

**TACOMA CO. BRITISH COLUMBIA.**

Office: 407 Globe Blk., Seattle, Wash. Primarily an iron ore and iron company, but has coal, gold, copper and stone claims. Advertises to be the greatest mining corporation on the Pacific slope, but neglects to give detailed answers to specific inquiries regarding its properties.

**TAMARACK MINING CO. MICHIGAN.**

Office: 199 Washington St., Boston, Mass. Mine office: Calumet, Houghton Co., Mich. Organized under laws of Michigan, with capitalization $1,500,000, in 60,000 shares of $25 par. Annual meeting, first Thursday in May. Albert S. Bigelow, president; W. J. Ladd, secretary and treasurer; A. S. Bigelow, W. J. Ladd, Jos. S. Bigelow, David M. Anthony, Edw. S. Grew and J. Henry Brooks, directors; Wm. E. Parnall, Jr., acting superintendent; Thos. Maslin, mining captain; John T. Reeder, clerk; J. B. Watson, mining engineer; A. L. Burgan, mill superintendent.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount of cash paid in on capital stock | $ 450,000.00 |
| Amount paid in by conveyance of property to company | 330,000.00 |
| Entire amount invested in real estate | 203,186.00 |
| Amount of personal estate | 2,421,460.09 |
| Amount of unsecured or floating debt | 1,881,924.76 |
| Production of copper, 1901, in pounds | 18,000,852 |

Items of income and expenditures for the year 1901 were as follows:

| | |
|---|---|
| Income | $2,627,954.35 |
| General expenses | 1,820,547.90 |
| Construction | 281,240.51 |
| Net earnings | 526,165.94 |
| Balance of assests Jan. 1, 1902 | 539,535.33 |
| Dividends paid in 1901 | 1,200,000.00 |

No dividends were paid in 1902.

Mining lands are 1,120 acres in Sections 10, 11, 14 and 15, Town 56 North, Range 33 West; also millsite on Torch Lake and extensive tracts of timber lands adjacent to mine and mill. The mine tract is of very irregular outline and is bounded on all sides by the lands of the Calumet & Hecla. The Tamarack is opened on the underlay of the Calumet conglomerate and the Osceola amygdaloid, the latter developed by crosscuts run east from the conglomerate workings. The mine was planned by the late Capt. John Daniell, who conceived the idea of opening the underlay of the conglomerate by a deep vertical shaft. The actual work of sinking No. 1 shaft was begun in 1882, and the conglomerate was cut in 1885, three and a half years after starting, at a depth of only 10′ greater than the estimate of Capt. Daniell, made before the first sod was cut. After the death of Capt, Daniell, in 1895, he was succeeded in the management by the late Capt. Wm. E. Parnall, and to these men jointly is due the lion's share of credit for the inception and development of the Tamarack.

The mine is opened by five shafts, Nos. 1 and 2 in the extreme southeastern corner being known as the Old Tamarack, and Nos. 3 and 4 as the North Tamarack. No. 1 cuts the conglomerate at 2,270′ and No. 2 at a slightly greater depth. These shafts have given the richest rock found in the mine, and from the 40 acres developed by them practically all the Tamarack dividends have been earned. No. 1 is 3,352′ deep, and nearly worked out. No. 2 is 4,250′ deep and produces about 400 tons daily. Some trouble was experienced during 1902 by the drawing of this shaft, owing to insufficient pillars. Shafts No. 1 and No. 2 are supplied with powerful hoists, good for the depth to which the shafts can be sunk.

Nos. 3 and 4, or the North Tamarack shafts, are about 1 mile north and slightly to the east of shafts 1 and 2. No. 3 is 4,799′ in depth and produces about 1,200 tons of stamp rock daily. The lode is wide but not remarkably rich. The surface equipment is very complete, including an Allis hoist having a double conical drum with diameter of 13′ 6″ at either end and 36′ 9″ in the center. The cable winds over specially built-up runs of steel affixed to the surface of the drum, which works in counterbalance. This hoist has raised a 10-ton load vertically at the rate of 55 miles an hour, and running at that speed has been brought to a stop in a distance of 75′, between two levels. This shaft has a 60-h. p. fan, 10′ in diameter with blades 3′ 6″ wide, capable of supplying 192,000 cubic feet of free air per minute to the depth of the shaft, nearly a mile. This fan not only ventilates the mine but also aids in reducing the temperature, which would otherwise be nearly 80° Fahrenheit in the bottom levels. The auxiliary hoist at No. 3, used for lowering and raising employes and for handling timber, is a Nordberg duplex with 32x72″ cylinders and 72″ stroke, having a drum 18′ 6″ in diameter with lathe-turned grooves for coiling the cable.

No. 4 shaft is 4,450′ deep and has not been deepened since bottomed in 1895. It has never been a producer, but is connected underground with No. 3, giving ventilation and safety to miners in case of accident in the North Tamarack workings.

No. 5, lying about midway between the Old Tamarack and North Tamarack shafts, is 4,938′ in depth, rendering it the deepest shaft in the world.

No. 5 was begun Aug. 7, 1895 and cut the conglomerate on Dec. 20, 1901, at a vertical depth of 4,662′, Capt. Parnall having foretold the depth within 12′ and the time within 11 days when the work was begun, six years before. The shaft has 5 compartments in a row, being 7x29′, inside measurement. The three central compartments are 7′ 2″x5′ and are used for cages. One of the end compartments, also used for a cage, is 7′ 2″x5′ 4″, the extra four inches being allowed for timber strain, while at the other end of the shaft is a compartment 7′2″x3′ for ladders, pipes and wires. The wall-plates of this shaft are 10x14″, and 29′ 2″ long. The runners, which serve as guides for the cages, are 5x7″ and 16′ to 22′ in length. Instead of countersinking the lag-screws, the runners have a central groove, 2″ wide and 1½″ deep, running from top to bottom on both sides of each of the 4 hoisting compartments, this groove providing for the escape of the lag-screws without damage to cages or runners, in case the screws work loose. The shaft openings have automatic covers that lift for the passage of the cages. In sinking this shaft 83 separate strata of trap, amygdaloid and conglomerate rocks, all barren, were cut before the Calumet conglomerate was reached. No sinking was done in 1902. Seven levels are opened, with drifts running both north and south, connection having been made with No. 2 shaft on the 29th level. In December, 1902, 34 power drills were running, producing about 600 tons of rock daily, without stoping. Production can be largely increased whenever wished. The bottom of the shaft is very hot, but the ventilation has been much better since connection was secured with No. 2.

The surface equipment at No. 5 is much the heaviest and most complete found at any part of the mine, the buildings being of stone and steel. The engine house, boiler house and compressor building are of redstone, with trussed iron roofs. The engine house has a 6,500-h. p. Nordberg hoist with 4 high pressure cylinders, each 36″ in diameter by 72″ stroke. Drums are 24′ in diameter and carry 6,500′ of 1½″ cable. A duplicate of this hoist is being installed and will go into commission in the spring of 1903. The cost of the first hoist was $60,000 and the duplicate will cost about $90,000, indicating an advance of 50% in cost of mining machinery since 1898–1899. The boiler house has 6 horizontal Burt boilers, with 84″ shells, and two 115′ brick-lined self-supporting steel smoke-stacks. Coal is brought in by cars over a railroad trestle.

The compressor building is 50x75′, with a 35-drill Ingersoll-Sergeant two-stage cross-compound air compressor, having 18x34″ steam cylinders with 36″ stroke. A 100-drill compressor was ordered some time ago and should have been installed in 1902, but has been greatly delayed. This will have 19x53″ steam cylinders with 48″ stroke and 3 pairs of two-stage air cylinders, each 18x27″ with 48″ stroke.

The shafthouse and rockhouse are on separate foundations and separately framed and braced, although apparently standing as one building, 56x120′ on the ground with an extreme height of 131′. These buildings were erected by the Wisconsin Bridge & Iron Co., at a cost of nearly $100,000. The foundations are exceptionally massive and the girders and framing are of unusual strength, to withstand the great strains caused by the hoisting of heavy cages and operation of the powerful rock-breaking machinery. These buildings required about 700 tons of steel and 100 tons of corrugated iron siding. Although 10 carloads of lumber were used in the building, no wood is exposed, except in the floors, asbestos sheathing paper being used elsewhere to protect the wood, thus rendering the building practically fireproof. The rockhouse has 3 crushers of the reciprocating jaw type, made by the Portage Lake Foundry & Machine Works, with room for 5 more when needed. A fine stone dry was built in 1902 and the old dry is used as a smithy. A new stone smithy is planned for 1903.

Water for the mine boilers and domestic uses is pumped from Lake Superior against a head of nearly 700′. The pumping station, 5 miles northwest of the mine, has a Nordberg duplex pump capable of raising nearly 1,500,000 gallons daily. Water is taken from a 40′ well on the lake shore, connected with a tunnel driven 480′ under the bed of the lake, with about 35′ of water above the intake. Water is delivered into 2 steel tanks on the highest point of the Tamarack lands. The larger tank is 65′ in diameter and 42′ high, the tanks having a combined storage capacity of 200,000 gallons. Water is distributed into mains from these standpipes. The pumping plant has developed marvellous efficiency, the cost of operation being only about $10 per diem, including fuel and wages.

The mine location is an extensive one, with a large number of dwellings for employes. The company maintains a $30,000 hospital, 60x60′ in size, with two full stories, basement and attic. The basement and first floor are of selected Lake Superior redstone, upper story and attic of frame, with interior finish of selected quarter-sawed Georgia pine. The building has emergency wards, operating rooms, dispensary, sun veranda, elevators, indirect steam heating and practically everything found in any modern hospital.

The Tamarack has two stamp mills, a little more than a mile south of the Calumet & Hecla mills, on Torch Lake. These have 7 stamps, with a daily capacity of fully 2,500 tons of conglomerate rock. The heads have been fitted with ⅛″ mortar-grates opening into revolving screens with ¼″ mesh having the Parnall-Krause hydraulic discharges. Finisher jigs have been replaced by Wilfley tables. The average cost of stamping a ton of rock was 31.48 cents in 1900 and 24.95 cents in 1901. Water for mills is furnished by a 40,000,000-gallon pump, operated jointly by the Osceola and Tamarack mills.

The wharves and steel coal sheds of the Tamarack and Osceola are at Dollar Bay, and are among the most extensive in the Lake Superior district.

Smelting is done at Dollar Bay, in the works of the Lake Superior Smelting Co., which is controlled by the Tamarack, Osceola and Isle Royale mining companies. The smelting company also has furnaces at Hancock, which are used as auxiliaries. Smelting costs are not obtainable, but are probably under $5 per ton. Many improvements have been made under the able superintendency of John J. Case, who has greatly improved the efficiency and economy of the plant. The smelter has two 100-ton reverberatory furnaces, in addition to blast furnaces. These take 25-ton charges and are surmounted by drying platforms for expelling moisture from the green mineral. All mineral is carried from the mills to the smelter in cars, thus saving the cost of barreling.

Production of the Tamarack probably decreased during 1902, owing to the operation of the mine under partial check. About 2,100 tons of rock were being stamped daily in December, 1902. Cost of making copper in 1901 was 11.67 cents per lb., but should show a decrease for 1903, if the mine is worked to its capacity.

**TAMARACK JUNIOR MINE. MICHIGAN.**

Owned and operated by the Osceola Consolidated Mining Co.

**TAMAYA MINE. CHILE.**

A mine of considerable importance in the past. Details are lacking regarding present condition. Is located about 65 miles from Coquimbo, Chile.

**TAM O'SHANTER MINE. NEVADA.**

At Sandy, Lincoln Co., Nev. J. R. Newberry, owner; J. Donovan, superintendent. Has a lead-copper ore body. No returns secured.

**TANGANYIKA CONCESSIONS, LTD. RHODESIA.**

Offices: 30-1, Clements Lane, London, E. C., Eng. Capitalized at £184,000. Debentures, £60,000 authorized, £45,000 issued. Tyndale White, chairman; R. Williams, managing director; L. Dampier, secretary; G. Grey, manager in Africa. Lands include concession of 2,000 acres for railroad and steamship terminals at southern end of Lake Tanganyika, and right to locate 2,000 square miles to the northward of the Zambesi river. Copper ore has been found on lands held by this company to the north of the Zambesi and Kafuke rivers.

**TARTANA, LTD. AUSTRALIA.**

Has 230-acre leasehold on the Walsh river, 30 miles from Chillagoe, Queensland. At last accounts was erecting a leaching plant. Hand-selected ore, running 15% and upwards, is sent to the Mt. Garnet smelters. A railroad, giving much-needed shipping facilities, was completed to the mine in 1902.

**TASMAN & CROWN LYELL EXTENDED MINING CO. TASMANIA.**

Address: care of Hon. N. J. Brown, agent, Hobart, Tasmania. Employs 6 men. Mine is being developed by an adit, which at last accounts was driven nearly 1,000′, and was expected to strike the Mt. Lyell lode on the underlay at a distance of approximately 1,100′.

**TASMAN LYELL COPPER CO., LTD. TASMANIA.**

Offices: 138, Leadenhall St., London, E. C., Eng. Mine office: Gormanston, Montague Co., Tasmania. D. J. Mackay, chairman; H. S. Muir, mine manager; H. M. Taylor, secretary. Capital, nominal, £300,000. Property, 200 acres at Mt. Lyell, Montague Co., Tasmania. Was employing 30 men in prospecting and development work at last accounts.

**TASMANIA COPPER MINING & MILLING CO. COLORADO.**

Office: 603 Provident Bldg., Philadelphia, Pa. Mine office: Winfield, Chaffee Co., Colo. Organized under laws of Colorado, with capitalization $1,000,000, shares $1 par. H. M. Smith, president. Lands, 37 claims, area 400 acres, near Winfield. Mine is opened by about 2,000′ of crosscut tunnels and management claims to have 750,000 tons of auriferous and argentiferous copper ore in sight. Company is endeavoring to raise money to install a concentrator.

**TASMANIAN COPPER CO., LTD. TASMANIA.**

Offices: 20, Bishopsgate St., London, E. C., Eng. Mine office: Roseberry, Tasmania. Idle. Capitalization, £325,000 in £1 shares. Frank L. Cox, chairman; Jos. G. Coldwells, secretary; C. M. Henrie, general manager. Lands, 386 acres, also 5-acre smelter site, in the West Coast district of Montague Co., Tasmania. Ore body is a fissure vein, 24′ wide and 3,000′ long, giving 1% to 3% copper, 3 dwts. gold and 10 oz. silver per ton. Ore is chalcopyrite, carrying zinc. Property is developed by tunnels, longest 644′; has about 1,600′ of underground openings; estimated amount of ore in sight, 400,000 tons. Company is securing an exemption from labor conditions imposed by the colony, pending the discovery of a suitable method of treatment for the ores, which, being both low in grade and refractory in reduction, offer a difficult problem.

**TAYLOR COPPER MINING CO., LTD. ONTARIO.**

Office: Sault Ste. Marie, Ont. R. H. Taylor, president. Lands are in the district of Algoma, Ont., and nine men were employed at last accounts. No returns secured.

**TECUMSEH COPPER MINING CO. MICHIGAN.**

Office: 15 Congress St., Boston, Mass. Mine office: Calumet, Houghton Co., Mich. John C. Watson, president; Daniel L. Demmon, secretary and treasurer; John C. Watson, F. H. Raymond, D. L. Demmon, Geo. H. Flint and Jas. Chynoweth, directors; Jas. Chynoweth, superintendent. Lands, 560 acres, next south of the Osceola mine. Organized under Michigan laws, with capitalization $2,500,000, shares, $25 par, 45,041 shares unissued. Several shafts have been sunk at various times, including one of 1,000′ on the Calumet conglomerate, which was barren, and another sunk to a depth of about 2,300′ on the Osceola lode. Work was discontinued November, 1902.

**TEHAMA MINING CO. CALIFORNIA.**

Office: Red Bluff, Cal. C. J. Gooch, president. Owns the Donkey mine, supposed to be a continuation of the Afterthought. Is said to have considerable body of fair grade ore. Idle for some years.

**TELEPHONE-ANCHOR CO. WYOMING.**

Mine office: Rambler, Wyo. Lee Campbell, superintendent. No returns secured.

**FUNDICION TEMPLEMAN, LTD. CHILE.**

Offices: 19, Birchin Lane, London, E. C., Eng. H. W. Kirby, chairman; E. B. Todd, secretary; T. R. Griffin, manager. Owns extensive smelters at Antofagasta, Chile, which have been considerably increased recently in capacity; also owns sundry mines, including the Atahualpa at Pica, Tarapaca Chile.

**TENNESSEE COPPER CO.** **TENNESSEE.**

Office: 11 Broadway, New York. Mine office: Copperhill, Polk Co., Tenn. Employs 920 men. Organized 1899, under laws of New Jersey, with capitalization $5,000,000, shares $25 par. Debentures, $500,000, in $1,000 twenty-year 5% bonds. J. Parke Channing, president; Frederick Lewisohn, vice-president; E. C. Westervelt, secretary; J. H. Sussman, treasurer. J. Parke Channing, Frederick Lewisohn and J. H. Sussman, executive committee; Randolph Adams, general manager; Wm. A. Heywood, smelter superintendent; B. B. Gottsberger, mining engineer; John Edwards, mining captain; State Street Trust Co. of Boston, registrar; Old Colony Trust Co., Boston, transfer agent.

For the year 1902 the company's profits from copper production, royalties, merchandise department and tolls were $303,012. Expenditures for bond issue, reserve interest, discounts and depreciation were $71,903, leaving a net profit of $231,109 for the year's operations. The profits of 1901 were $55,725, giving a total operating profit of $286,834 to Dec. 31, 1902.

Lands are 2,080 acres of mineral property, also 11,000 acres of miscellaneous lands, in the Ducktown district of Polk Co., Tenn., showing 6 series of lenses, of which 3 are being developed. Ore bodies occur as lenses in fissure veins averaging 30′ to 70′ in width and running 500′ to 2,000′ in length, with average depth of 400′, carrying chalcopyrite with pyrite in a quartz gangue, averaging 2% to 4% copper, with traces of gold and silver. The lenses are in metamorphic schists and have extensive gossan cappings. The country rock is micaceous schist of pre-Cambrian age. Some oxide ore was found at surface, but was mined out long ago. Ore is excellently adapted to cheap and close concentration, and as zinc and other refractory elements occur in insignificant quantities, the ore smelts well and gives very clean slags.

The principal producer is the Burra Burra mine, carrying one of the largest lenses of ore in the United States. The mines in the present consolidation were opened circa 1850, and were considerably developed and regularly operated before the Civil War. The mine has one shaft of 280′ and two shafts of 400′ each, sunk in the solid footwall to guard against drawing. The underground openings are about 6,500′, not including worked-out stopes, and about 1,500,000 tons of ore are blocked out for stoping. The Burra Burra has a shafthouse 127′ high, where ore is reduced to 4″ size. The mine has complete machinery plant, including water-tube boilers, Nordberg first-motion hoists and a Nordberg cross-compound two-stage air compressor. The shafthouses serve the purpose of a concentrator and are equipped with 100-h. p. compound engines, 18x36″ crushers, 42x144″ screens and 36″x33′ Robins conveying belts for the hand-picking of ores. The daily capacity of the shafthouses is 2,000 tons of assorted ore.

The smelter is located at Isabella Junction, a little north of the old Tennessee mine and one to five miles from the other mines of the company. Ore is taken to the smelter by the company's 7½ mile standard gauge private railroad, connecting with the Atlantic, Knoxville & Western railway. The rolling stock includes four 50-ton locomotives and 65 thirty-ton ore cars.

The ore is a massive sulphide, averaging about 2.5% copper, 27% sulphur, 15% silica and 40% iron. This is heap-roasted at an average cost of 35 cents per ton, in roast yards having a capacity of 135,000 tons, covered with sheds to prevent the leaching of copper values from rains. The roast-heaps are burned for an average of 10 to 11 weeks. The smelter is admirably designed and equipped, having been planned by J. Parke Channing, and built under his supervision. The structure is of steel, with large ore bins, and has a daily capacity of 1,000 tons. There are 2 water-jacket blast furnaces, 56x180" at the tuyeres, 72x180" at the top and 18' from tuyeres to the charging floor. A limited amount of barren quartz is used as flux in furnace mixtures. The furnaces are charged by two-ton cars drawn by electric locomotives, which also handle the slag-pots, the slag being used as railroad ballast. There is a 25-ton refining furnace and two stands of converters, with shells 84x126". There are two Nordberg cross-compound condensing blowing engines, with steam cylinders 56" and 56x42", running 66 revolutions per minute and delivering air at a blast pressure of 35 to 40 oz. per square inch. There is also a horizontal blower for the converters. Flue dust is saved in a large dust-chamber and re-smelted. The power-house is of brick, and in addition to the boilers and blowing engines has pumps and an electric plant, the latter furnishing power for the smelter locomotives and light for the various buildings.

For 1902 the production was 8,103,534 lbs. of refined copper. Smelting costs were about 35 cents per ton for heap-roasting and $1.05 per ton for matting, which may be accounted excellent work. For the third week in December, 1902, the two furnaces smelted 6,370 tons of calcined ore and 1,115 tons of flue dust, converter slags and matte, an average smelting charge of 1,069 tons per day for two furnaces, with a consumption of only 907 tons of coke for the week, giving the remarkable efficiency of upwards of 8 tons of ore smelted with each ton of coke. The company will install a third blast furnace in 1903 and will also deepen the shafts and open new levels in the mine.

The actual cost of production for 1903 was about 9 cents per lb., although the smelter had but one furnace in blast during the first five months of the year. With a third furnace in operation and the benefit of a few minor economies rendered possible by experience, the Tennessee should secure a production of about 12,000,000 lbs. in 1902, at a cost of about 8 cents per pound. The property has the benefit of an exceptionally strong and well-balanced management.

**TEXAS CONSOLIDATED MINE. CALIFORNIA.**

Sometimes called the Hart mine. Located at Old Diggings, Shasta Co., Cal. Was preparing to resume work at last accounts.

**TEXAS COPPER CO. TEXAS.**

Address: care of Glen N. Congdon, Gowanda, N. Y. Organized July, 1902, under laws of New York, with capitalization $1,000,000. Supposed to have copper, salt and gypsum claims in Texas. No returns secured.

**TEZIUTLAN COPPER CO. MEXICO.**

Office: 27 William St., New York. Mine office: La Aurora, Teziutlan, Puebla, Mexico. Employs approximately 1,000 men. Organized under laws of New Jersey, with capitalization $1,000,000, shares $100 par, fully paid. Geo. D. Barron, president and general manager; Robert S. Towne, vice-president; C. J. Nourse, Jr., secretary and treasurer; E. R. Dalbey, local manager at plant; A. F. Schneider, mill superintendent; E. du B. Lukis, mining engineer. Mining lands, 4,005 acres, smelter site, 15 acres, miscellaneous lands, 400 acres, all in the Teziutlan district, Puebla, Mexico. Smelter is adjacent to the mine and receives ore by aerial tram. Smelter is large and thoroughly modern, power for operation being transmitted from an electric station utilizing a waterfall 4½ miles from the mine. Product is turned out as blister copper, averaging 98.6% fine. Mine is served by the Inter-Oceanic Railway of Mexico. Property is generally regarded as of unusual promise.

**THARSIS SULPHUR & COPPER CO., LTD.** **SPAIN.**

Offices: 136, West George St., Glasgow, Scotland. Mine office: Alosno, Huelva, Spain. Sir C. Tennant, Bart., chairman; A. Moore, Jr. and R. C. Mackenzie, auditors; Wm. P. Rutherford, mine manager; D. Barlas, secretary; Cyril E. Brackenbury, consulting engineer. Registered October 27, 1866, with capital £1,250,000, shares £2 par. Warrants to bearer issued. Net income for 1901 was £263,678, from which dividends of 20% were paid, being 8s. per share, or £250,000, leaving a surplus of £43,786. Company has paid annual dividends since 1890, ranging from 10% in 1894, the smallest, to 37½% in 1899, the largest. Production of ore was 468,738 long tons in 1900 and 400,162 long tons in 1901, showing a considerable decrease. Production of refined copper has been as follows: 11,147 long tons in 1898; 9,448 tons in 1899; 7,967 tons in 1900; 7,427 tons in 1901. The decrease is due to the partial exhaustion of the Tharsis and Laguanazo properties.

Lands of the Tharsis company include the Tharsis group, area 1,133 hectares, and the Laguanazo group, area 271 hectares, at Alosno, about 30 miles west of the Rio Tinto; also the Calañas group, area 618 hectares, at Calañas, midway between the Tharsis and the Rio Tinto. The mines at Alosno were worked by the Romans, and probably by their predecessors as well, and are identified by some with the Tharsish of the Scriptures. General geological conditions are the same as at the Rio Tinto. The mines are in the southern zone of the Andevallo or Sierra Morena district of Huelva, and show 4 main lenses, these having their axes of greatest length southeast by northwest. The largest lense is the Criadero del Sur, to the south. The Filon del Norte, to the northeast, is about 600 metres long, with 140 metres extreme width. The two smaller lenses are the Criadero de la Sierra Buillones and the Filon del Medio, to the northwest. The end of these lenses is in sight, and although good for a large production for some years to come, their exhaustion is merely a matter of time. In order to replace them the company is developing the Almegrera and Triunfo groups at Alosno, and also the Laguanazo. The Calañas is increasing production.

The ore is piled in heaps and weathered, the process being assisted by occasional sprinklings. The leach-water goes into creosoted timber sluices, where the copper in solution is deposited on pig iron. The company owns a railway leading from the mine to Corales and has a shipping pier at that port. The company also owns extensive works at Hebburn-on-Tyne; Willington-on-Tyne; at Oldbury, a suburb of Birmingham; at Garngad, a suburb of Glasgow, and at Cardiff, Wales. Owing to the certainty of the ultimate exhaustion of its principal mines, the company is making active efforts towards securing new mines, and has recently bought the Aamdal mine in Norway. American mines in Tennessee and Arizona have also been investigated, with a view to lease or purchase, and Mr. Brackenbury is now inspecting sundry mines in Italy, Cyprus and Russia.

**THREE JAYS COPPER CO.** **BRITISH COLUMBIA.**

A property near Alberni, B. C., which shipped ore to the Tacoma smelter in 1901–1902. No returns secured.

**THREE PEAKS MINING CO.** **CALIFORNIA.**

Address: care of T. S. Henderson & Co., St. Louis, Mo. J. J. Chambers, vice-president and general manager. Property is in Trinity Co., California, and ores carry gold and copper. No returns secured.

**ASOCIACION DE PROPRIETARIOS DE LAS MINAS DEL TIBIADO.** **SPAIN.**

Offices: Moncada 21, Barcelona, Spain. Mining property is at Tibiado, Barcelona, Spain. Ores are chalcopyrite.

**TIGER MINE.** **NEVADA.**

At Lovelock, Humboldt Co., Nev. J. A. Nelson, owner. Was driving a tunnel with small force at last accounts.

**TILT COVE COPPER CO., LTD.** **NEWFOUNDLAND.**

Offices: 9, Queen St. Place, London, E. C., Eng. Col. J. W. Young, chairman; E. C. Leaver, secretary. Capital, nominal, £200,000; issued, £178,000. Company has paid dividends. Property, held in freehold, at Tilt Cove, Nfld., is leased to Cape Copper Co., Ltd., for 99 years from 1891, at annual rental of £4,400 and one-half the net profits, lease being terminable on one year's notice.

**TIMBER PEAK MINING CO.** **NEW MEXICO.**

Mine office: Socorro, Socorro Co., N. M. C. T. Brown, manager. Has gold-silver-copper ores, opened by shafts, with steam power equipment and 150-ton concentrator. Was working 50 men at last accounts.

**TINTIC MINING & DEVELOPMENT CO.** **UTAH.**

Office: Salt Lake City, Utah. Mine office: Bingham Canyon, Salt Lake Co., Utah. Geo. H. Robinson, general manager; W. J. Craig, superintendent; Has a 900′ shaft, carrying good copper, gold and silver values for entire distance. Also has a 2,300′ tunnel, which has cut a 25′ vein carrying argentiferous and auriferous sulphide copper ores giving average assays of 4% copper and $5.60 gold per ton, with considerable silver values.

**SOCIETE TINTO & SANTA ROSA.** **SPAIN.**

Office: Brussels, Belgium. Property, 11 mines, area 114 hectares, near Zalamea, Huelva, Spain. Output for 1899 was 760 long tons of copper.

**TIPTON COPPER CO.** **NEW MEXICO.**

Letter addressed to company at Tularosa, Donna Ana Co., N. M., returned unclaimed, October, 1902.

**TIP TOP MINE.** **IDAHO.**

At Doniphan, Blaine Co., Idaho. J. A. Lusk, superintendent. Has gold and copper ores. Is equipped with steam and electric power and has a 20-stamp mill and 50-ton cyanide plant. Employs about 50 men and secures a little copper as a by-product.

**TIPTOP MINE.** **ONTARIO.**

Address: care of Folger Bros., managers, Ft. William, Ont. Mine is in Moss Twp., Round Lake, Thunder Bay district, Ontario. Has chalcopyrite in quartzose gangue, and shows a little bornite at bottom of shaft. Development work was continued during 1902.

**SOCIEDAD ANONYMA MINES METALIQUES DE TOLOSA.** **SPAIN.**

At Tolosa, Navarra, Spain. Is developing the Leiza mine, carrying chalcopyrite and galena.

**TOLTEC CONSOLIDATED MINE.** **MICHIGAN.**

A tract of 320 acres at Greenland, Ontonagon Co., Mich., just north of the Hilton mine of the Adventure Consolidated Co. Worked 1851–1860, and produced 206 tons, 1,443 lbs. of copper, at a loss of about $500,000.

**TOM HAL MINING CO.** **WASHINGTON.**

Mine office; Pateros, Wash. Tom B. Warren, president and general manager. Lands, 5 claims, with vein of 4′ to 10′, richest where narrowest, carrying pyrite, arsenopyrite and chalcopyrite, all auriferous and slightly argentiferous.

**TOMAHAWK COPPER & ZINC MINING CO.**

Office: 132 Broadway, New York. Location of company's properties unknown. No returns secured.

**TORCH LAKE MINING CO.** **MICHIGAN.**

Address: care of W. W. Stockley, agent, Hancock, Mich. Lands, 1,280 acres, midway between Calumet and Lake Linden, Houghton Co., Mich. Capitalization, $500,000, shares $25 par. Was prospected by diamond drill, in 1899-1900.

**TORPEDO MINING CO.** **NEW MEXICO.**

Mine office: Organ, Donna Ana Co., N. M. Geo. E. Wood, president; Harvey A. Rich, vice-president and secretary; R. T. Anderson, superintendent. Property adjoins the mine of the Copper Bar Co., and has an excellent equipment of machinery. Has produced upwards of 4,000 tons of ore. Company composed of men of good business reputations. No returns secured.

**TRAINOR MINE.** **COLORADO.**

At Ashcroft, Pitkin Co., Colo. Michael Hogan, owner; Wm. P. Green, superintendent. Was developing silver-lead-copper ores, by tunnel, at last accounts.

**TRANSVAAL COPPER CO., LTD.** **SOUTH AFRICA.**

Offices: 19–21, Queen Victoria St., London, E. C., Eng. N. F. Nalder, secretary. Cannot be learned that company has done anything except to incorporate.

**TRAVERSELLA MINES, LTD. ITALY.**

Offices: Broadway Chambers, Westminster, London, S. W., Eng., and Rue de Chateaudun, 40, Paris, France. Sir E. J. Reed, chairman; Baron R. Watteville, managing director; A. Froment, mine manager. T. O. Dear, secretary. Capital, nominal, £120,100. Property, copper and iron mines, area about 4,000 acres, in commune of Traversella, Turin, Italy. Was installing an Elmore oil concentration plant at last accounts.

**GEORGE A. TREADWELL MINING CO. ARIZONA.**

Office: 27 William St., New York. Mine office: Prescott, Yavapai Co., Ariz. Employs 60 men. Organized 1899, under laws of West Virginia, with capitalization $3,000,000, shares $10 par, non-assessable. Geo. A. Treadwell, president; Walter S. Logan, vice-president; Miss Myra B. Martin, secretary and treasurer; Erwin D. Treadwell, general manager. Lands, 99 claims, 48 patented, area 1,976 acres, also smelter sites aggregating 180 acres, in the Verde and Big Bug districts of Yavapai Co., Arizona. Five different lenses and fissure veins are being developed, these having widths of 10′ to 200′, with unknown length and depth. Ores are sulphide, carrying varying values in copper, gold and silver. Principal development has been secured on the Brookshire group, where a large ore body is being opened by shaft and tunnel, giving a concentrating ore that should average 5% copper. Mines are opened by four shafts, with aggregate depth of 1,100′, and two tunnels, with aggregate length of 2,500′. Has about 10,000′ of underground openings. Mine has steam power equipment, including air compressors, one 160-h. p. hoist, three 40-h. p. hoists, etc. Is nearly ready to begin production, but management cannot say just when the start will be made. At the close of 1902 the mine was in a position to raise about 100 tons of ore daily, and was installing a 100-ton hydro-carbon smelter, which is planned to burn crude petroleum for fuel. Should the hydro-carbon process prove a success it will be a boon to many mines far from good carbonaceous fuel.

**TREVINO & ZERTUCHE. MEXICO.**

Address: Francisco F. Trevino and Tomas Zertuche Trevino, owners, Viesca, Coahuila, Mexico. The firm owns and operates several groups of mines producing gold, silver, lead, copper and iron and employs about 100 men.

**TRIMOUNTAIN MINING CO. MICHIGAN.**

Office: 60 State St., Boston, Mass. Mine office: Trimountain, Houghton Co., Mich. Organized 1899, under laws of Michigan, with capitalization $2,500,000, shares $25 par. Old Colony Trust Co., registrar. Annual meeting, second Wednesday in February. H. F. Fay, president; W. B. Mosman, secretary; Geo. G. Endicott, treasurer; Jas. Chynoweth, superintendent; H. F. Fay, Geo. G. Endicott, John C. Watson, Wm. Howell Reed, B. Nason Hamlin, W. B. Mosman and Jas. Chynoweth, directors; Wm. J. Uren, assistant superintendent; Thos. Rapson, mining captain; John Knox, surface superintendent; H. T. Mercer, mining engineer; John M. Wagner, clerk; Will

Harris, supply clerk; Edw. Koepel, mill superintendent; Edw. Bates, master mechanic.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $900,000.00 |
| Amount paid in by conveyance of property to company | 800,000.00 |
| Entire amount invested in real estate | 803,000.00 |
| Amount of personal estate | 69,479.99 |

An assessment of $3 was levied in 1902, making $20 per share paid in. The expenditures for 1901 were $568,759.99, including construction work at mine and mill. A dividend will be paid early in 1903.

Mining lands are 1,120 acres, consisting of the east half of Section 19; the west half of Section 20; the north half of Section 29 and the northeast quarter of Section 30, all in Town 54 North, Range 34 West. The Baltic lies to the north and the Champion to the south, with undeveloped lands east and west. The millsite on Lake Superior has 100 acres. Mining was begun in 1899. The Trimountain has a very heavy sand overburden surmounting the ledge, hence the opening of new shafts is no simple matter. Shafts are opened by sinking drop-shafts through the sand and crosscutting to the lode, opening thence to surface. The Baltic lode runs 15′ to 50′ wide on the Trimountain tract, with an average of about 25′, the lode being well mineralized across its entire width, mass and barrel copper occurring near the walls. Masses upwards of a ton in weight have been found, but the main reliance is on the stamp rock, which is of exceptional uniformity and richness. Lying about 75′ west of the Baltic lode is a parallel amygdaloid, of even greater average width, showing excellent stamp-rock in bunches, but, so far as opened, considerably below the Baltic lode in average value. The shafts are all of the same size and style, being 8x22′ outside of timbers and framed with 14x14″ beams, exceptionally heavy timbering being required to withstand the pressure from the shifting sand above the solid rock. Each shaft has 3 compartments, 2 for skips and one for pipes and ladders.

No.1 shaft is about 210′ north of the boundary line between the Champion and the Trimountain, and was 1,040′ deep on Dec. 1, 1902. The shaft is sunk at an angle of 68°, there being an overburden of about 40′ of sand, with first level opened at 168′ below the collar of the shaft, and levels 100′ apart from thence downward. This shaft shows very long stretches of exceptionally uniform high-grade stoping ground. This shaft has a direct acting 2,500-h. p. Nordberg hoist with 36x72″ cylinders and 18′ drum, which can raise a 6-ton skip 1,000′, dump the rock and lower the skip to whence it started in 60 seconds. The hoist was taken from No. 4 shaft of the Arcadian and is practically new. During 1902 the Trimountain bought 3 hoists and 3 shafthouses with complete equipment from the Arcadian mine, and transferred the same to the Trimountain shafts. The combination shaft-rockhouse is 40x62′ on the ground and 84′ high. Equipment includes engine, steamhammer and two 18x24″ crushers, with room for two more crushers. The ore bins have storage capacity for 2,000 tons of rock.

No. 2 shaft is 1,023′ northeast of No. 1 and is 950′ deep, sunk at an angle of 68°. Equipment is practically the same as at No. 2.

No. 3 is 1,027′ northeast of No. 2 and is 865′ deep, sunk at an angle of 68°. The sand overburden is about 60′ deep at this point, and the ground is disturbed above the second level, but the formation becomes regular lower down, the shaft showing many excellent stopes. The hoist and shaft-rock-houses are similar to those at shafts 1 and 2.

No. 4 shaft was 35′ deep on December 1, 1902. This was opened by a perpendicular sand-shaft which struck the ledge at 140′, a crosscut being sent to the Baltic lode from the bottom of the sand-shaft. The ground is well mineralized and highly promising, so far as can be judged from the limited openings secured.

Shafts 5 and 6 are in embryo, but will be opened later. No. 6 will develop the Trimountain territory to the Baltic line. The mine has underground openings of nearly five miles at the close of 1902.

The principal mine buildings and machinery are in the neighborhood of shafts 2 and 3. The machine shop is 32x45′; carpenter shop 40x60′; smithy 25x45′ and warehouse 30x60′. All shops are well supplied with modern machinery and tools. There is a 35-drill cross-compound Rand air compressor at No. 2 shaft, with Deane condensing plant in a separate building adjoining. At No. 3 shaft the power plant is housed in a steel building 68x180′, the plant including a 60-drill air compressor, secured from the Arcadian, a Nordberg hoist and battery of Stirling water-tube boilers. There is a large coal trestle supplying fuel to the boiler room and a cistern at No. 2 shaft stores water from a small brook for the boilers. A house has been built over the cistern, and has a fire pump, with hose, for defense of the mine buildings.

The company has upwards of 100 good dwellings at the mine location, all new, 46 six-room dwellings having been built in 1902. There is also a large boarding house and store. The location is growing rapidly, and is improved with well macadamized roads. The Trimountain is served by the Painesdale branch of the Copper Range Railroad.

The millsite, of 100 acres, is on Lake Superior, at Beacon Hill, two miles west of Redridge, with ample frontage for wasting sands. The mill is 176x215′, of steel on stone foundations. The Trimountain began production Jan. 4, 1902, with one leased head at the Arcadian mill. A second head at the Arcadian was started about April 1. The first stamp in the Trimountain mill was started in the fall of 1902, and at the close of the year two heads are in commission, with a third nearly ready to start and a fourth being installed. One or more heads will probably be used at the Arcadian mill for some time. The Trimountain mill has 4 Nordberg stamps, each with 36 improved Hodge jigs, 6 slime tables and 1 Wilfley table. A small but complete machine shop for mill repairs is fitted up on the second floor. The boiler house at the mill is of steel, with brick-lined self-supporting steel smokestack 7′6″ in diameter and 165′ high. The boiler house has four 250-h. p. Stirling water-tube boilers. At the rear of the boiler house are three coal trestles, under each of which is a 6x7′ tunnel 400′ long, with a down-grade tram to the boiler rooms, for loaded cars. The floors of the coal sheds form the roofs of the tunnels, and cars are loaded by gravity. Water for the boilers is piped from a dam across a small stream 1,000′ distant.

The steel pumphouse has a 20,000,000-gallon Nordberg pump. Water is taken from a pump-well, connected by a 40″ riveted steel pipe running 1,400′ to an intake crib in Lake Superior. The crib, which is sunk in 21′ of water and built of heavy timber framing braced by iron rods, is 42x56′ on the bottom and 31′ high, weighted with 1,800 tons of rock and anchored into the sandstone bed of the lake by heavy iron rods. The 40″ water pipe is laid on the floor of the lake from the crib until shallow water is reached, after which it lies in the bottom of a trench blasted to a uniform depth of 14′. The pipe is anchored between the crib and the end of the trench by cement sunk in sacks on each side.

Miscellaneous buildings at the mill include the smithy and carpenter shop, each 18x30′, and a 24x36′ warehouse. The townsite of Beacon Hill, lying on the slope above the mill, has a number of dwellings. Townsite and mill buildings are lighted by electricity from a dynamo in the engine room of the mill.

The Trimountain is employing about 1,000 men at the close of 1902, and is destined to speedily take a prominent position among the large copper producers of the United States. The production of 1902 was probably upwards of 5,000,000 lbs. of copper, and for 1903 should be about 15,000,000 lbs. Additional milling facilities will probably be required within a year or two after the present mill is in full commission. The prediction made in the last issue of this book that the Trimountain would probably secure 1½% copper from its rock stamped has been fully verified. The management is aggressive and the property is being developed and handled most commendably.

**TRINITY COPPER CO.** **CALIFORNIA.**

Mine and office: Kennett, Shasta Co., Cal. The eastern office in Boston was abolished by vote of shareholders at the annual meeting in October, 1902. Organized 1900, under laws of New Jersey, with capitalization $6,000,000, shares $25 par. Thos. W. Lawson, president; Wm. J. Riley, vice-president; Homer Albers, secretary; Allen Arnold, treasurer; preceding officers, Louis Auerbach, Arthur P. French, Henry H. Arnold, Frank E. Chase and Kenneth K. McLaren, directors; Austin H. Brown, general manager; American Loan & Trust Co., Boston, transfer agent; International Trust Co., Boston, registrar.

The Trinity has about 1,700 acres of mineral lands, also a 422-acre smelter site near Kennett, and total holdings, including mining lands, townsite, smelter site, etc., of 3,655 acres, all patented. Principal mining holdings are the Shasta King group and adjoining claims, and the King Copper group and adjoining claims, these having nearly 100 claims in all. The Shasta King group of 12 patented claims is on the south fork of Squaw Creek and adjoins the Balaklala mine. The King Copper group of 22 claims is about 2½ miles south of the Shasta King, and has about 1,000′ of development work, no ore having been found in place as yet, although the existence of considerable ore bodies is reasonably certain. The Statesman group is now under development with a view to locating and developing silicious ores required for fluxing. The Uncle Sam group is held under option and lease by the Trinity company and is also being explored for fluxing ores. The Trinity has large bodies of low-grade cupriferous iron sulphides, but lacks the silicious ores required to make easy smelting furnace mixtures. Considerable oxide ore has been found at and near surface, running 3% to 8% copper, but the main ore body is a disseminated chalcopyrite, averaging probably 2½% to 4% copper and carrying gold and silver values of probably between $1 and $2 per ton.

The principal development is at the Shasta King, which is opened by tunnels, the main tunnel being 7x8' and 1,145' long, with double tram tracks. A 7x8' double-track tunnel is also being driven 175' lower. The mine has 7,230' of underground openings and the tract has been partially explored by 5,119' of diamond drill borings. The main ore body is a lens approximately 150' wide by 1,000 long, with depth unknown, but estimated by the company at 1,000'. This lense gives every evidence of strength and is likely to prove persistent to good depth. The mine is said to have upwards of 1,000,000 tons of ore in sight, with nearly 500,000 tons blocked out for stoping, at the close of 1902. The crosscut tunnels, driven in from the sides of the mountain, are connected by drifts in ore.

Surface improvements include office, assay office, hospital, warehouse, shops and about 25 dwellings for employes. The operating plant has steam power, a 6-drill air compressor, power drills and one diamond drill. The smelter site at Kennett is 8 miles from the mine, with which it is connected by railroad. Grading was begun for 750-ton concentrator and smelter, but was discontinued late in 1901. The Trinity was dickering with Capt. J. R. DeLaMar for the purchase of the Bully Hill mine, but that property was sold to the Mt. Shasta Gold Mines Corporation.

The Trinity has a large amount of ore developed, with an even larger amount in sight, but the property must be operated on a very large scale to become profitable, and should have a reduction plant with concentrator and smelter of not less than 1,000 tons daily capacity. The great desideratum of the present is a sufficient body of silicious copper ore to obviate the necessity for using barren fluxes in furnace mixtures.

**TRIUMPH GOLD-COPPER CONSOLIDATED MINING, SMELTING, LAND & IRRIGATION CO.** **ARIZONA.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. Company issues a very pretty little prospectus, containing an enticing cut of the Copper Queen smelters at Bisbee, Ariz., and states that "an independent smelting works, similar to this, is to be later erected by the company." Promoters of this company are notorious frauds. See Excelsior Copper Co.

**TROY GOLD MINING CO.** **COLORADO.**

Mine office: Granite, Chaffee Co., Col. G. Faulconer, superintendent.

Has gold-silver-copper ores, with steam power equipment and a 20-ton concentrator. No returns secured.

**TROY-MANHATTAN COPPER CO. ARIZONA.**

Office: Postal Telegraph Bldg., New York. Mine office: Troy, Pinal Co., Ariz. Employs 75 men. Thos. Kavanaugh, superintendent. Organized July, 1902, under laws of Maine, with capitalization $3,000,000, having $2,500,000 issued, shares $10 par. Present company absorbed and succeeded the Troy Copper Co. and the Manhattan Copper Co., which had adjoining properties. Company is said to have a considerable cash surplus and be in a strong financial position. Lands, approximately 1,200 acres, in the Troy district of Pinal Co., Arizona. Principal mining developments are on the Troy property, which includes the Alice, Climax, Buckeye and "91" groups, with aggregate area of 567 acres. The Troy has four shafts, of which the deepest, 500′, has 2 compartments. The mine also has about 7,000′ of tunnels. Ores are oxides and sulphides, with estimated average values of 12%, smelter returns for 1902 having given an average of about 10% copper. Vein is 3′ to 11′ wide and gaining in width at the bottom of the Alice shaft, where it is very soft and requires spilling. The mine has two gasoline hoists, Leyner air compressor and an electric plant, with other necessary machinery. The smelter has a 60-ton furnace and capacity is to be increased to 250 tons in 1903. The furnace turns out high grade black copper, and was in operation more or less during 1901 and 1902, but was closed down September 1902, owing to a shortage of both coke and water; supposed to have been blown in again, December, 1902. The expensive wagon haul of 75 miles has been a serious drawback in past operations, but it is expected that a railroad will be completed to within 7 miles of the mine in 1903.

**TRUE BLUE COPPER MINES, LTD. BRITISH COLUMBIA.**

Lands, 6 claims, on Houser Creek, Ainsworth division, Slocan district, B. C. Said to have exposed fair values in copper by 700′ of development work in 1901. Idle at last accounts.

**TRUST RUBY MINE. COLORADO.**

At Ouray, Ouray Co., Colo. John Wahl, superintendent. Is said to have copper, lead and iron ores. No returns secured.

**TUBUTAMA MINING & REDUCTION CO. MEXICO.**

Has valuable mining property in the Altar district of Sonora, Mexico, adjacent to the property of the Sonora Mining & Milling Company, and is said to be preparing for development work upon an extensive scale. Holdings of company include 390 pertenencias, area 963 acres. A number of "antiguas," or old Spanish mines, were developed on this property. Col. T. Bryan, J. L. F. Swain, J. S. Hurst and W. E. Van Slyke are among the incorporators, and are men of good standing.

**TUCK MINE. VIRGINIA.**

Located on the Hyco river and A. & D. branch of the Southern railway in the Red Bank district of Halifax Co., Va. Tract is 156 acres in fee simple and mineral rights to 709 additional acres. Has three persistent mineral veins, 2′ to 12′ wide, apparently true fissures. One has been traced about

9,000′, with good surface showing for about one mile. Eight shallow pits have been bottomed in ore on another vein. No. 8 pit is down 20′ in a 7′ vein, a selected sample therefrom assaying 57% copper and $23.50 gold per ton.

**TULLY COPPER MINING CO. COLORADO.**

Office: Encampment, Carbon Co., Wyo. Mine office: Pearl, Larimer Co., Col. Employs 7 men. Organized 1901, under laws of Wyoming, with capitalization $1,000,000, shares $1 par, non-assessable. Leo Davis, president and general manager; J. D. Tully, vice-president and superintendent; F. J. Lordier, secretary; B. A. Marr, treasurer. Directors are preceding officers, Theodore Davis, A. T. Marr and C. B. Blake. Lands, 12 acres, unpatented, with millsite of 6 acres, showing 4 fissure veins carrying oxide and carbonate ores. Ore body being developed has an average width of 25′ and estimated length of 4,500′, with estimated values 6% copper and $4 gold per ton. Has two 30′ shafts and one 175′ shaft. Is equipped with steam power. Company will continue development work in 1903, and contemplates erection of a 100-ton smelter.

**TUNABERG MINE. SWEDEN.**

A silver-lead-copper producer, 588′ deep at last accounts. Is worked mainly for silver, but a little copper is secured as a by-product.

**TURGOVSKI WORKS. RUSSIA.**

At Perm, Russia, in the Ural district. D. C. Zaharovski, manager. Latest available returns show a production of 3,342 poods of refined copper in 1899.

**TURQUOISE COPPER MINING CO. ARIZONA.**

Mine office: Pearce, Cochise Co., Ariz. Thos. Lavery, superintendent. Has steam and gasoline power. No returns secured.

**TWIN BUTTES MINING CO. ARIZONA.**

Mine office: Tucson, Pima Co., Ariz. Has copper-silver-lead ores, developed by open cuts.

**TWIN-EDWARDS COPPER MINE CO. NORTH CAROLINA.**

Office: Greensboro, Guilford Co., N. C. Organized September, 1902, with capitalization $100,000, shares $100 par. Is reopening the old Twin-Edwards copper mines, near Greensboro. Assays show good auriferous ore. The Twin mine was worked before the Civil War, and had an 18′ vein.

**TWO BIT GOLD & COPPER MINING CO. COLORADO.**

Property supposed to be located in the Two Bit mining district of Colorado, but no reliable data secured.

**TYEE COPPER CO., LTD. BRITISH COLUMBIA.**

Offices: 45, Leadenhall St., London, E. C., Eng. Mine office: Duncan's Station, Vancouver Island, B. C. T. H. Wilson, chairman; Clement Livingstone, local director and manager; Wm. Thompson & Co., consulting engineers; W. Gardner, secretary; Thos. Kidder, smelter superintendent. Capital, nominal, £180,000. Lands, 240 acres on Mt. Sicker, Vancouver Island, B. C., held in freehold, but with coal and iron reserved by former owners. Main shaft, 330′ deep at last accounts, showing ore body up to 35′ in width.

Smelter returns from 1901 shipments gave 8% copper, 5 oz. silver and $5 gold per ton. Company has a 100-ton water-jacket furnace at Ladysmith, on Oyster Harbor, B. C., to be blown in very early in 1903. Foundations are laid for a good sized concentrator, and aerial tramway from mine to smelter is under construction. Property is apparently of considerable promise.

**TZAREVO-ALEXANDROVSKI WORKS. SIBERIA.**

A mine at Semipalitinsk, Siberia, with an average annual production of about 250 metric tons.

**UGURCHAISKA & GALIZURSKI MINES. RUSSIA.**

In the government of Elizapethpol, Russia. Owned by Kunderov Bros. G. Chaimazidi, manager, Batum, Russia. No returns seceured.

**ULIDA GROUP. CALIFORNIA.**

Address: care of Wm. L. Hunter, owner, Lone Pine, Cal. Lands are in Inyo Co., Cal., and include 8 prospects showing contact veins between limestone and granite, ores being malachite, tetrahedrite and cuprite, both auriferous and argentiferous. Malachite outcroppings 10′ to 20′ wide are noted. A little development has been secured and mine has made limited smelter shipments of hand-sorted high-grade ore.

**UNAWEEP COPPER MINING & MILLING CO. COLORADO.**

Office: probably Lynn, Mass. Geo. H. Allen, president; Henry Merrill, treasurer; Jas. V. Howard, secretary, Grand Junction, Colorado. Lands, 6 claims and a millsite, in Unaweep mining district of Colorado. Development work has been done on 2 properties. Directors are men of good standing, but give no returns in response to repeated requests.

**UNCLE SAM COPPER CO. ARIZONA.**

Office: 523 Douglas Bldg., Los Angeles, Cal. Mine office: Gilbert, Yavapai Co., Ariz. Employs 3 men. Organized 1901, under laws of Arizona, with capitalization $1,000,000, shares $1 par. Milo Baker, president; A. J. Gastren, vice-president; W. T. Somers, secretary, treasurer and general manager. Lands, 12 unpatented claims, area 240 acres, in Yavapai county, showing several ore bodies, of which one is 125′ between walls, and more or less mineralized for full width, showing sulphide ores carrying varying quantities of gold, silver and copper. The vein matter has stringers of rich copper ores, iron oxide and porphyry, these carrying values of about $75 per ton. Has two shafts of 100′ each, and several shallow shafts and pits. Company will sink shaft to 500′ depth and install a hoist in 1903.

**UNION COPPER MINING CO. CALIFORNIA.**

Mine office: Copperopolis, Calaveras Co., Cal. G. McM. Ross, general manager; David Ross, superintendent. A controlling stock interest has long been held by the estate of Fredk. L. Ames, of Boston. This was the most important copper producer of California, previous to the developments in Shasta county since 1897. The Union was opened circa 1861 and the Union and Keystone mines, the latter long since consolidated with the Union, shipped 62,219 tons of 15% ore 1861-1866, mainly to Swansea, and the property paid considerable dividends. The mine was reopened in 1887, closed in 1892, and again reopened in 1900. Lands include the Union and Keystone mines, also the Empire group and adjoining tracts, in Calaveras county, and are commonly known as the Copperopolis mines. The company also owns two claims adjoining the Alta, in Del Norte county, Cal. The formation at Copperopolis is a black pyritous slate in amphibolite schists, this belt running from Tuolumne county on the south through Calaveras into Amador county on the north. The vein of pyritous slate is 3′ to 40′ wide with a strike of 30° east of south and a dip of 30° to the east. Property lies at an elevation of 1,100′ above sea level. The ore occurs as lenses of chalcopyrite, connected by stringers, the lenses having an average width of about 15′, the main lens being 2′ to 40′ wide and 600′ long. The alteration zone, only about 30′ in depth, carries a little native copper and rich oxides and carbonates, below which occurs chalcopyrite, carrying neither gold nor silver and unusually free from arsenic, antimony, bismuth and other undesirable elements. So pure is the ore that the blister copper therefrom makes good wirebars without electrolytic refining. The product is classified in two grades, as smelting ore carrying 10% to 11%, and leaching ore carrying 5% to 5.5% copper. The main shaft is 60′ deep, bottomed in a 15′ vein of medium grade ore, and the mine has 5,254′ of openings in ore. The property has a good hoist, pumps, etc., and necessary mine buildings. A 100-ton Orford smelter was installed in 1889, but is not in blast. Operations are confined at present to making cement copper from the old dumps, which are extensive, with a force of 10 men.

**UNION COPPER MINING CO. NORTH CAROLINA.**

Office: 11 Broadway, New York. Mine office: Gold Hill, Rowan Co., N. C. Organized 1899, under laws of New Jersey, with capitalization $3,000,000, shares $10 par. Annual meeting in May. Watson & Brown, 80 Broadway, New York, transfer agents. Calvin H. Allen, president; Temple T. Berdan, secretary; Thos. C. Buck, treasurer; preceding officers, Vernon C. Brown, Jacob Field, John L. Drummond, R. P. Doremus, A. Fletcher, Jr. and W. M. Butler, directors.

Lands comprise about 1,150 acres of mineral territory, in Rowan and Cabarrus counties, N. C., about 15 miles from Salisbury. The tract is well watered and quite heavily timbered. Lands carry 13 copper veins and one vein each of gold, silver and lead, a little work having been done on the silver and gold veins. Principal mining developments are on the "Big Cut" copper vein, on which 10 shafts have been sunk, there being 3 main working shafts, about 500′ deep each. This ore body carries a little native copper and oxidized ore in the upper portion, with chalcopyrite below a shallow depth. Assays of this vein have been claimed to average 10% copper, $1.50 to $7.50 gold and 3 to 30 oz. silver per ton. It is safer, however, to take the assays of Dr. A. R. LeDoux, which give averages of 4% to 5% copper, 40 cents to $1.20 gold and 3 to 5 oz. silver per ton. The mine has a concentrator and smelter, which were planned to have an ultimate capacity of 500 tons each. The smelter has roasters and two 40-ton furnaces, blown in Sept. 20, 1901, and blown out in June 1902, since which time the mine has shipped concentrates, the production for September, 1902, having been about 200 tons of concentrates averaging 18% to 20% in tenor. About 50 men are now employed.

The affairs of the company seem to have been badly handled in the past but the present management is apparently making every effort toward economical operation. Expenditures of the company to the close of 1902 are variously estimated at $1,000,000 to $1,500,000. The machinery plant is very extensive, though not so well planned as might be wished, including 27 boilers, 18 hoists, 3 air compressors, complete electric light plant, etc. There are 4 dams, with water storage capacity for three months' operation of the reduction plant. Buildings include concentrator, smelter, machine shop 45x75', smithy 40x60', iron and brass foundry, sundry engine and boiler houses, stable for 400 horses and mules, office building, 52-room hotel and about 130 dwellings for employes in the townsite adjoining the mine. There is also a sawmill with daily capacity of 25,000' of lumber.

**UNION COPPER MINING CO. WYOMING.**

Office and mine: Encampment, Carbon Co., Wyo. Organized under laws of Wyoming, with capitalization $1,000,000, shares $1 par. Lands, about 100 acres. Was developing vein by shaft, with steam power equipment and small force, at last accounts.

**UNION COPPER SMELTING CO.**

Address: care of Wm. F. Wernse & Co. Bond & Stock Co., 421 Olive St., St. Louis, Mo. A very dubious proposition. See Excelsior Copper Co.

**UNION COPPER LAND & MINING CO. MICHIGAN.**

Office: 60 State St., Boston, Mass. Reincorporated 1893, under laws of Michigan, with capitalization $2,500,000, shares $25 par, 20,000 shares unissued. Annual meeting, fourth Tuesday of March. Old Colony Trust Company, of Boston, registrar. H. F. Fay, president; W. B. Mosman, secretary and treasurer; H. F. Fay, John C. Watson, W. B. Mosman, Wm. I. Colby, Stephen R. Dow and R. R. Goodell, directors; Jas. Chynoweth, superintendent. Company owns upwards of 7,000 acres of land, practically all on the mineral belt, in Keweenaw, Houghton and Ontonagon counties, Michigan. Much of the land is covered with valuable timber. Company had a cash balance, Jan. 1, 1901, of $101,170.74.

**UNION DEVELOPMENT CO. CALIFORNIA.**

Supposed to have an office in Boston, but letter not delivered by postal authorities. Property is the Juanita claim, in the Morrow district, 26 miles east of Johannesburg, San Bernardino Co., Cal. Vein is apparently a contact between granite and limestone. Ore is chalcopyrite in a talcose gangue, carrying $3 gold per ton. Has four shafts, deepest 212'.

**UNITED ALKALI CO., LTD. SPAIN.**

Office: St. Helens, England. Spanish office: Huelva, Spain. Wm. Guthrie Bowie, mine manager. Capital, £8,750,000. This is a great chemical and manufacturing corporation, with which mining is merely an incident. The company has extensive works at St. Helens, Runcorn, Flint, Widness and Glasgow, and makes extensive use of Spanish and Portuguese pyrites, which are burned for sulphur. The cinder of the cupriferous pyrites is treated for copper, which is secured by cementation.

The principal Spanish holdings of the company are the Monte Rubio group of mines, owned by C. & J. Sundheim, and held on royalty under lease secured in fall of 1902. The Monte Rubio group includes the Monte Rubio, Gibraltar and Atbalcal Arbalcal groups of old mine workings, having a combined area of upwards of 100 hectares. These mines have been worked only to the level of the nearest stream by the Romans and their successors. The deposit is really an iron ore body carrying copper in many forms, as oxides, carbonates, sulphides and sulphates. The old workings, though comparatively superficial, disclose enormous masses of ore and the indications favor the existence of extensive deposits of unaltered iron-sulphides at greater depth. Company also has some important leases of mineral lands on the river Guadiana, which will be thoroughly tested later, and plans building a railroad of 22 kilometres from Monte Rubio to Coiña Veral, on the Guadiana, and establishing wharves at that point, for ore shipments to Great Britain.

**UNITED BINGHAM GOLD & COPPER MINING CO. UTAH.**

Office: Salt Lake City, Utah. Louis Moore, president; Adrian Hanauer, Jr., secretary. Lands, several acres of patented ground in the Bingham district of Salt Lake Co. It is said to be the company's plan to work this ground through the tunnel of the United States Mining Co. No returns secured.

**UNITED BUFA MINES. MEXICO.**

Office: 1 Exchange place, Jersey City, N. J. Organized 1903, under laws of New Jersey, with capitalization $300,000, shares $1 par, to mine copper and other ores in Mexico.

**UNITED COPPER CO. MONTANA.**

Office: 31 Nassau St., New York. Mine office; Butte, Silver Bow Co., Mont. Organized Apr. 28, 1902, under laws of New Jersey, with capitalization $80,000,000, in $5,000,000 preferred stock paying semi-annual dividends of 3%, and $75,000,000 common stock in 750,000 shares, par $100, of which 450,000 shares have been issued. Said to have begun business May 1, 1902, with $600,000 cash surplus, and to have ended 1902 with a surplus of nearly $1,000,000. F. August Heinze, president; Arthur P. Heinze, first vice-president; John MacGinnis, second vice-president; Richard Lacy, secretary; Stanley Gifford, treasurer; F. A. Heinze, John MacGinnis, Stephen E. Nash, A. A. Brownlee, Henry Budge, A. P. Heinze, Jacob Langeloth, Frederick Whittridge and G. Reusens, directors; Hallgarten & Co., of New York, transfer agents; Metropolitan Trust Co., of New York, registrar. Stock is listed on the Boston exchange.

This is a securities holding corporation, its assets consisting exclusively of stock in subsidiary corporations, and is organized along the same general lines as the Amalgamated Copper Co., which the United Copper Co. was formed to fight, and with which it will doubtless be amalgamated in time, unless it should happen that the Amalgamated be united with the United instead of the United being amalgamated with the Amalgamated. F. A. Heinze and his associates in the Montana Ore Purchasing Co. are credited with holding considerably more than a controlling interest in the stock issue.

The United Copper Co. began business as the owner of 76,791 shares of the Montana Ore Purchasing Co.; 123,500 shares of Nipper Consolidated Copper Co.; 950,000 shares of the Belmont Mining Co.; 1,900,000 shares of Cora-Rock Island Mining Co. and 2,950,000 shares of Minnie Healy Mining Co., this being 95% of the stock issue of each company named. In addition, the United Copper Co. owns the entire issue of $1,000,000 first mortgage bonds of the Montana Ore Purchasing Co. and the entire issue of $2,500,000 first mortgage bonds of the Nipper Consolidated Copper Co. The principal value of these holdings lies in the stock of the Montana Ore Purchasing Co., which, with its various subsidiary corporations, is engaged in extensive litigation with the Amalgamated Copper Co., there being nearly 100 separate actions at law between these corporations, with no seeming possibility that the litigation will ever be ended, except by the collapse of one of the companies or by mutual agreement outside of the courts. The Johnston and Rarus mines of the Montana Ore Purchasing Co. adjoin the Pennsylvania mine of the Boston & Montana Co., controlled by the Amalgamated, and all of these properties are in such a fog of litigation that it not only would be hopeless, but a sheer waste of time as well, to attempt to give any lucid explanation of this muddle, which engages the time of a small army of lawyers, clerks and mining experts, and clogs the courts of Montana with an amount of litigation that apparently cannot be adjudicated in court within the next hundred years. The Minnie Healy is also effectually tied up by litigation and is in the hands of a receiver. The lawsuits connected with the other mines of the United Copper Co. are comparatively few and unimportant, judged by the Montana standard.

The Cora is said to be showing excellent values. The Minnie Healy is undoubtedly a very valuable mine, but its future is enveloped in a haze of lawsuits. The Rarus mine of the Montana Ore Purchasing Co. is probably the best of the Heinze properties.

The first semi-annual dividend of 3% on the preferred stock was paid Nov. 1, 1902, and the company hopes to pay a 2% dividend on the outstanding common stock on May 1, 1903, the first anniversary of the company's organization.

The United Copper Co. suffered serious loss by the burning of the concentrator at Butte that was used by the various subsidiary corporations. Concentration is now being effected at Basin, Jefferson Co., Mont., some distance from the mines. Production of the various mines controlled by the United Copper Co. was at the rate of more than 2,500,000 lbs. monthly, at the close of 1902. The nominal productive capacity of the various mines may be placed at 35,000,000 to 40,000,000 lbs. of refined copper yearly, when equipped with full concentrating and smelting facilities.

**UNITED COPPER-GOLD MINING & EXTRACTION CO. ARIZONA.**

Address: care of A. Stearns, president, Cleveland, Ohio; Benj. J. Perry, vice-president and general manager, Denver, Colorado. Capitalized at

$1,000,000, shares $1 par. Lands, 5 claims, area about 95 acres, near Wickenburg, Maricopa Co., Ariz., are said to show an ore body of 18′ to 24′, assaying 15% copper, $8 gold and 13 to 20 oz. silver per ton.

**UNITED GERMAN COPPER MINES, LTD.** **GERMANY.**

Had an office at 21, Finsbury Pavement, London, E. C., Eng., but letter so addressed was returned unclaimed October, 1902. Property of company was at Muenster-am-Stein, Bavaria, Germany.

**UNITED GLOBE MINES.** **ARIZONA.**

Office: 99 John St., New York. Mine office: Globe, Gila Co., Ariz. Jas. Douglas, president; Geo. Notman, secretary and treasurer; N. S. Berray, superintendent. Lands, next west of the Old Dominion group, in the Globe district of Gila Co. Has been worked for some years, largest production having been 2,847,460 lbs. in 1898. Output for 1901 was 830,100 lbs. No copper was made in 1902, and company does not expect to make any in 1903. Ore is a highly silicious sulphide, requiring heavy fluxing. Has a 200-ton smelter at the mine, which has been idle for several years, ore being shipped to El Paso for reduction, on account of lack of suitable cupriferous flux in the Globe district. Company secured a flat rate of $13 per ton, in November, 1902, on ore shipped from Globe to El Paso. Company will continue exploratory and development work in 1903.

**UNITED GOLD & COPPER CO.** **NEW MEXICO & CALIFORNIA.**

Office. 801-159 LaSalle St., Chicago, Ill. Branch offices: New York; Columbus, Ohio; Santa Fe, N. M. Mine office: Lordsburg, Grant Co., N. M. Organized 1902, under laws of New Mexico, with capitalization $5,000,000, shares $1 par. R. M. Wilbur, president; F. W. Norwood, vice-president; W. F. Weyburn, secretary; Wilson I. Davenny, assistant secretary; D. A. Walker, treasurer. Lands are in New Mexico and California. New Mexico holdings are 4 groups, area 400 acres, about 5 miles from Santa Fe, N. M., showing auriferous and argentiferous oxide and carbonate ores of copper. The second New Mexican group has 7 claims, area 140 acres, in the Gallinas district of Lincoln Co., showing a dike ranging 10′ to 100′ in width, carrying copper, gold and silver. The third New Mexican group is 4 claims, area 120 acres, in the San Andreas district of Socorro Co., 40 miles east of Engle, where workings show two large fissure veins, giving good assay values in copper, lead, silver and gold. The fourth group in New Mexico has 5 claims, area 100 acres, in the Shakespeare or Virginia district of Grant Co. This group is being developed. Company is also opening gold mines in the Cherokee district, about 10 miles from Oroville, Butte Co., Cal., on 8 claims, area 100 acres, carrying gold placers and a quartz lode, the latter having about 1,700′ of underground openings.

**UNITED METALS SELLING CO.**

Office: 11 Broadway, New York. Organized 1899, to take over the metal brokerage business of Lewisohn Bros. Jesse Lewisohn, president; Adolph Lewisohn, Jesse Lewisohn and Urban H. Broughton, executive committee. The company does a general brokerage business in metals, the great bulk of its trade being in copper, of which it is much the largest broker of the world.

**UNITED STATES MINING CO.** **UTAH.**

Office: 4 Postoffice Square, Boston, Mass. Western office: 508 Dooly Blk., Salt Lake City, Utah. Mine offices: Bingham Canyon, Salt Lake Co., Utah, and Tintic, Juab Co., Utah. Organized 1899 and reorganized 1901, with capitalization $21,500,000, in 860,000 shares, par $25, of which 420,000 shares, or approximately one-half of the authorized capital, were issued at the close of 1902. Company has an authorized bond issue of $600,000, of which $320,000 of first mortgage bonds are outstanding, these having been called for payment Sept. 1, 1903, at 105 and accrued interest. Bondholders are given the option of exchanging debentures for capital stock at par, until retirement of bonds. Company also has a floating debt, estimated at $400,000.

Robert D. Evans, president; F. W. Batchelder, secretary; Albert F. Holden, general manager; A. P. Maybury, superintendent; Geo. H. Fischer, smelter superintendent; Richard E. Parker, consulting engineer; Aron Hirsch & Sohn, Halberstadt, Germany, sales agents, represented in the United States by L. Vogelstein, of New York.

The mines of the company are in two groups, one at Bingham and one at Tintic. The properties at Bingham, which were the original holdings of the company, include the Telegraph, Old Jordan, Niagara and adjoining claims. The Niagara, which is apparently of the least importance, is held through a stock interest, and minority stockholders have fomented more or less litigation. The Telegraph and Old Jordan were originally silver mines, opened on a fissure vein of silver-lead ore crossing the big sulphide copper bed from which the present production is secured. The copper ores are silicious and deficient in iron, but in connection with the iron-sulphide ores of the Tintic group furnish an excellent furnace mixture. The Bingham ores range in tenor from 1.5% to 2% in copper, with $1 to $2 in gold and 2 to 5 oz. silver per ton. The mine openings are very extensive and ore is carried by trestles from the mines to Bingham Junction.

The Tintic group includes the Centennial-Eureka and Tintic mines. Control of the Centennial-Eureka is held through ownership of all but about 100 shares of the capital stock. The Centennial-Eureka has been a large dividend payer in the past. The Tintic properties are old and deep mines, having been opened to about 1,500′ depth. The ore is found in two grades, the oxides and carbonates carrying high values in gold and silver and ranging from $10 to $30 per ton in value, with upwards of 150,000 tons developed. The low-grade deposits are of enormous extent but carry only small gold and silver values. In December, 1902, the Centennial-Eureka was opening what is apparently a large body of high-grade ore, giving average assays of 5% copper, $6 gold and 40 to 50 oz. silver per ton. The various mines of the United States Co. have about 2,000,000 tons of ore blocked out for stoping, of which about 90% is low grade. The mines are equipped with steam and electric power.

The smelter is at Bingham Junction, in the neighborhood of the works of the Utah and Bingham companies. The reduction plant is exceptionally well planned and complete in every appointment, having been built at a cost of considerably more than $700,000. The smelter was planned by Geo. K. Fischer and erected under his supervision. The operation of the plant is rendered automatic, as far as possible, by the adoption of the latest mechanical devices. It is expected that this plant will do more or less custom work, in addition to handling the ores of the company. Fires were started in September, 1902, for a trial run, and the first furnace went into regular commission early in November, 1902, with 3 furnaces in blast at the close of the year, and 2 more nearly completed, to be blown in early in 1903, while the sixth and last furnace will be completed and blown in a few months later. The furnaces are of 250 tons nominal capacity each, and use the pyritic system, utilizing the sulphur in the ore as fuel. The converter plant has a daily capacity of 850 tons. Limestone is used for fluxing. Ore is smelted to 20% to 22% matte at the first fusion, and blown up to 40% to 50% matte in the second blast. Blister copper from the converters is sent to the Delamar works at Carteret, N. J., for electrolytic refining. The smelter has an electric plant for operating the traveling cranes and furnishing light. The plant has worked very smoothly from the start, and slag losses are only 0.2%, which is very good practice.

Barring unforseen contingencies, the United States should make 10,000,000 to 12,000,000 lbs. of copper in 1903, and after wiping out the floating debt should be able to retire the bonds in September, 1903. If the bondholders exchange for stock, as is likely to be the case, the company should be able to declare a small dividend about Jan. 1, 1904. Although the ores are of very low average grade the mines are extensively developed, the plant is unusually complete, and the management of the company is good.

**UNITED STATES MINING & SMELTING CO. MEXICO.**

Jos. G. Kitchell, president; Henry Voorce Brandenburg, treasurer; Thos. B. Johnson, El Paso, Texas, mine superintendent. Capitalization $5,000,000. Lands, about 45 miles from Hermosillo, Sonora, including the San Jose de Gracia, or Ajogada mine. No answers received to requests for information.

**UNITED STATES & GUERRERO EXPLORATION CO. MEXICO.**

Office: Ashland, Ky. Capitalization, $1,000,000. Dr. J. Letton Martin, president. Property, 148 acres, near the Pacific ocean, in the states of Michoacan and Guerrero, Mexico, lands in the former state being near the Inguaran.

**UNITED VERDE COPPER CO. UTAH.**

Office: 49 Wall St., Boston, Mass. Mine office: Jerome, Yavapai Co., Ariz. Organized 1899, under laws of West Virginia, with capitalization $3,000,000, shares $10 par, succeeding the corporation of the same title organized under the laws of New York, the assets of the old company having been transferred to the new corporation at the nominal figure of $500,000. Bonded debt authorized, $3,000,000, due Sept. 30, 1949; outstanding bonds, $2,299,680. Company is conducted as a close corporation and Senator W. A. Clark is supposed to own about 90% of the capital stock. Annual meeting, third Monday in February. Dividend payments given later, in connection with production and costs, at end of this article. W. A. Clark, president; Jas. A. McDonald, vice-president; J. C. Kennedy, secretary and treasurer; W. A. Clark, Jas. A.

McDonald, Chas. W. Clark, Henry Atwater, Jas. Kitchen, directors; Jos. L. Giroux, manager; H. J. Allen, superintendent; Otto Strodthoff, chief clerk.

The United Verde was originally a small gold and silver mine, until bought by Senator Clark in 1888. Mineral lands are 13 patented claims, area 250 acres, with sundry adjoining lands, located in the Black Hill range at an elevation of 5,600′ above sea level and 1,800′ above the valley of the Rio Verde. The mine is in a zone of slates and intrusive dioritic rocks, the neighboring limestone being unconformably superimposed and apparently having no connection with the ore deposits. The mine is opened on a single monstrous lense of sulphide ore, in slate, the lense having a dip of 72° and being intruded by a quartzite dike 70′ wide, carrying about 1% copper and 1 to 13 oz. gold per ton, which is used for converter linings. The gossan outcrop carries auriferous and argentiferous oxide and carbonate ores to a depth of about 160′; these ores have been largely worked out. The zone of secondary enrichment carries mainly chalcocite, with some covellite and other alteration minerals of copper, all highly argentiferous. The unaltered ores, mainly chalcopyrite, with a little bornite, are both auriferous and argentiferous. In mining no assortment is made and no concentration is attempted, everything from the mine openings going to the furnaces, the average of the ore taken from the openings being 7% to 8% copper. There are very few copper mines that can do this. The ore is very rich in sulphur and much heat is generated, spontaneous combustion being frequent. Access to the mine is secured with extreme difficulty and only upon a written order from Senator Clark, and such orders are remarkably scarce. Employes are cautioned against giving out any information whatever regarding the underground openings. A practical miner of good judgment and veracity assures me, from personal investigation, that the mine is fully opened to about the seventh level and has "hundreds of acres of ground opened for stoping." Possibly this is too high an estimate, but it is known that the advance openings are very extensive and the ore reserves enormous. Estimates of ore in sight vary greatly, and are mere guesses at best, but a conservative figure of the ore developed would be 15,000,000 to 20,000,000 tons, containing between 1,000,000 and 1,500,000 tons of pure copper. This ore is developed above the 600′ level and diamond drill borings show ore to a depth of about 2,000′. Whether the ore is leaner in the bottom is not known, but in all likelihood it decreases materially in all metallic values at depth. The lense is at least 1,900′ long, with an extreme width of 600′. The mine is worked pillar-and-stall, and timbering, when used, is placed as square sets. Worked-out stopes are filled with barren rock blasted from the mountain side above the mine and milled into the abandoned stopes. This practice is regarded as somewhat dangerous. The deepest shaft of the mine is but 700′ and much trouble has been experienced in the past from the drawing of shafts. The main working shaft is 6x18′, equipped with two double-deck cages and has a 700-h. p. hoist, capable of raising 3-ton loads from a depth of 2,000′. A large new shaft 900′ from the main working shaft has 5 compartments, and will have four cages, worked in counterbalance. The mine is equipped underground with electric haulage.

The ore, owing to excess of sulphur, frequently catches fire from spontaneous combustion. A sharp watch is kept for such fires, and whenever possible they are caught at their inception and extinguished. When the fires get beyond control the burning ground is walled in by solid masonry bulkheads and the fire is allowed to burn itself out, or failing that, to burn on. Owing to the more or less shattered condition of the lense, it is difficult to entirely prevent access of air, and very little air will keep a fire in a sulphide ore mine burning indefinitely. In August, 1902, a fire that had been burning since 1897 on the third level, where some stopes run 56% sulphur, broke out on the fifth level, causing a total suspension of mining. The smelter was closed and the entire force laid off. All surface openings were sealed and an attempt made to extinguish the fire by pumping the mine full of carbonic acid gas. The carbon dioxide was made by treating crushed limestone with dilute sulphuric acid, in iron tanks, the gas being forced by its own pressure into the top of the shaft, whence it fell by gravity to the bottom of the mine, displacing the atmospheric air. The fire was thought to be under control and the mine and smelter were opened about the middle of November, after some three months of idleness, and at the close of 1902 two furnaces out of six were in blast again. It is hinted that the owners took advantage of the fire to eliminate a certain class of labor, as considerable friction had developed between the management and the Miners' Union. The mine is subject to bad caves, one of which carried down the office building and killed a number of employes several years ago. From the miners' standpoint the United Verde is not an especially desirable working place. The openings are very hot and the acid waters cause blisters and sores upon the unprotected skin, while the mine fires and caves render underground work more or less dangerous.

All ore from the mine is sent to the 500′ level, and thence trammed through a 1,300′ tunnel to the roast-yard, where the ore is heap-roasted with cordwood, on contract, in 500-ton heaps, six weeks being the average time required for roasting each heap. When roasted the ore is trammed back into the mine through the tunnel, and hoisted through the shafts to the smelter, the exceedingly precipitous nature of the ground rendering it impracticable to secure direct connection between the smelter and roast-yard except through the mine. The smelter and the town of Jerome, which has grown up around this mine, are in a narrow gorge and the smelter stands squarely on top of the mine. Much trouble has been experienced from the settling of the mine, which has more than once injured the buildings and machinery.

The smelter is of 800 tons daily capacity, having 6 water-jacket blast furnaces of 160 tons capacity each, and 1 reverberatory furnace for smelting ores especially rich in gold and silver and for reducing the flue dust, also a tilting casting-furnace for making anodes of blister copper. It is said that four of the 160-ton furnaces will be replaced by furnaces of 300 or 400 tons capacity each. The smelter has two 50-ton electric traveling cranes for handling matte, slags and converter shells. There are six stands of converters, with 15 mammoth shells. A 350-h. p. engine and dynamo furnish electric light and power. Two of the 150-h. p. engines in the smelter have been replaced by engines with aggregate capacity of 1,000 h. p. The smelter stack has a screen top, to catch flue dust. The surface equipment of the mine is very complete, although the plant is badly cramped for room, and electric power is very extensively used, both on surface and underground. Anodes from the smelter are shipped to New Jersey for electrolytic refining, Senator Clark's Waclark Wire Works at Elizabeth, N. J., taking a considerable part of the refined copper. The water from the mine is leached through tanks near the smelter, and the copper carried in solution is precipitated on scrap iron. The water supply is scant, coming from a considerable distance by gravity, and is carefully husbanded. The coke for the smelter comes from Senator Clark's coal mines at Gallup, N. M., costing $12 to $15 per ton, and wood for the roast-heaps costs $8 per cord. Coal and coke being scarce and high-priced, experiments with crude petroleum were made by the smelter during 1902, with fair prospects of success. The United Verde gives employment normally to 1,200 to 1,500 men, the miners working 8-hour shifts, at good wages.

The town of Jerome is dependent on the United Verde for an existence. Senator Clark has built a $250,000 hotel, which furnishes rooms at $5 per month and table board at $7 per week to employes, these figures being merely the ordinary boarding-house charges in Arizona. Jerome is connected with the outside world by the United Verde & Pacific R. R., a narrow-gauge line of 28 miles, running from the mine to Jerome Junction. This line was built at heavy cost and under very great engineering difficulties.

The production of refined copper by the United Verde increased from 22,327,950 lbs. in 1896 to 43,995,332 lbs. in 1899, this being the maximum production secured. Owing to a bad cave and mine fires, the output decreased to 39,970,193 lbs. in 1900, and to 34,520,695 lbs. in 1901, while the output for 1902 was probably under 30,000,000 lbs., owing to the long stoppage of the mine and smelter during the fire. The normal output of the present plant, when worked to its full capacity, is 40,000,000 to 50,000,000 lbs. per year. With more water, more room for roast-heaps and more smelting capacity, the mine could make 100,000,000 lbs. yearly as easily as its present production is secured. In any case a new smelter will be necessary eventually, as a block of ore carrying upwards of 100,000,000 lbs. of copper is required to hold up the present smelter, while at that the underpinning is none too secure.

There is probably no other copper mine regarding which so much rot has been printed, this being due partially to the wonderful richness of the property and its comparative inaccessibility, but mainly to the secretive policy of the management. The dividend payments of the mine were begun in 1892, on the basis of 25 cents per share monthly, and in 1896 were increased to 50 cents per month and again increased in 1898 to $1 per month. Dividend payments, 1892–1895, at $900,000 per year, were $3,600,000; in 1896–1897 were $1,800,000 per year and in 1898–1899 were $3,600,000 per year, aggregating $14,400,000. Dividends for 1900 were $4,498,680, being the largest in the mine's history, and giving total dividend payments of $18,898,680 to Dec. 31, 1900. Net earnings for 1900 were $5,435,970. Dividends for 1901 were

75 cents per month, giving a total of $2,700,000, and for 1902 were said to be $1 per month, or a total of $3,600,000, but it is doubtful if this amount was actually paid. The net earnings of the mine, divided by the production for 1900, show a profit of 13.59 cents per lb., which, taken from the average market price of copper, show the cost of copper to have been about 3 cents per lb. laid down at the seaboard. This figure, of course, is secured by deducting the gross gold and silver values from the cost of the copper. Under unusual circumstances, such as occurred in 1902, the cost per pound of product may have reached as high as 5 or 6 cents, but under normal conditions the United Verde makes its copper for 3 to 4 cents per pound.

**UNITED VERDE EXTENSION MINING CO. ARIZONA.**

Mine office: Providence, Yavapai Co., Ariz. B. L. Jones, superintendent. Organized 1894, under laws of Arizona, with capitalization $3,000,000, shares $10 par; practically reorganized in 1899. First mining ventures, at Jerome, proved disastrous, whereupon new property was secured in the vicinity of Providence. The Red Rock mine is now being developed and is said to give a good showing.

**UNITED VERDE JUNIOR COPPER CO. ARIZONA.**

Office: 60 State St., Boston, Mass. Mine office: Jerome, Yavapai Co., Ariz. Organized 1899, under laws of West Virginia, with capitalization $2,000,000, shares $10 par. American Loan & Trust Co., Boston, transfer agent. Benj. F. Peach, president; Henry N. Fisher, vice-president; Edwin Wallace, secretary and treasurer. A large amount of stock was placed in the east at $5 per share and has since sold at 8 cents per share. No returns secured, and property is regarded as of very doubtful value.

**UNITY COPPER & GOLD MINING CO. NEW MEXICO.**

Property, 12 mining claims, area about 240 acres, in the Bromide district, near Tres Piedras, Rio Arriba Co., N. M. Considerable development work has been done and property said to have a good showing of chalcopyrite and bornite, also some tetrahedrite and gold values. No returns secured.

**UNIVERSAL COPPER MINING CORPORATION, LTD.**

Offices: 31, Lombard St., London, E. C., Eng. F. Richards, secretary. Capital, nominal, £40,000. No returns secured.

**UREA MINING CO. MEXICO.**

Mine office: Velardena, Durango, Mexico. Was opening copper-silver-lead ores, with Henry Willhoff as superintendent, at last accounts.

**UTAH CONSOLIDATED MINES CO. UTAH.**

Office: 52 Broadway, New York. English office: 4, Great Winchester St., London, E. C., Eng. Mine office: Bingham Canyon, Utah. This is a corporation having wheels within wheels, according to the most modern system of finance. The Utah Cons. Gold Mines, Ltd., succeeded the Sevier Gold Mines, Ltd., in October, 1896, and the capitalization of £250,000 was increased to £300,000, March, 1897. The Utah Cons. Gold Mines, Ltd. has no property except 2,490 shares of stock in the Highland Boy Gold Mining Co. of New Jersey, same being practically the entire stock issue. The direct title to the mining property is held by the Highland Boy company. Owing to the high taxes imposed by the British government on dividend disbursements, it is being arranged, at the close of 1902, to transfer the property, which, as before stated, consists of stock in the Highland Boy, to a new corporation, to be known as the Utah Consolidated Mines Co., organized under the laws of New Jersey, with capitalization $1,500,000 in 300,000 shares of $5 par. It is estimated that this transfer will save about $40,000 yearly, in taxes and general expenses of the London office, and the change is acceptable to the English shareholders, who hold only 25% to 30% of the total stock issue.

Officers of the English company are as follows: John E. Dudley Ryder, chairman; Geo. H. Johnson, secretary; F. P. Addicks, assistant secretary, in New York; Urban H. Broughton, general manager. Mr. Broughton has generally been referred to as the president of the company, and will doubtless be president of the new American corporation. W. R. Smith, general superintendent; Wm. M. Johnson, mine superintendent; International Trust Co., of Boston, transfer agent; Massachusetts Loan and Trust Co., of Boston, registrar. The major part of the stock issue of the English corporation has been deposited with the International Trust Co., of Boston, which has issued certificates against such stock, and these certificates are listed and traded in on the Boston exchange.

The English company paid two 5s. dividends in 1901, a total of £150,000. No dividends were paid in 1902, but a dividend of 7s. per share, or £105,000, was declared December 22, 1902, payable Jan. 15, 1903.

Lands are 239 acres, held by the Highland Boy Gold Mining Co., in Carr Fork Gulch, also the Yampa group, carrying the extension of the Highland Boy ore bodies, bought in 1901, all in the West Mountain or Bingham district of Salt Lake County, Utah. The ore is low grade, running 2% to 4% copper, with $2 to $3 gold and 1.5 oz. silver per ton. The ore occurs in chimneys or chutes, and carries about 30% each of iron, silica and sulphur, rendering it practically self-fluxing. There are 3 of these chimneys, of which the largest is approximately 200x350′ in area and of unknown depth. There are also strong indications that the property has additional chutes. Important new ore bodies have been located and developed in 1901–1902. The mine has one shaft of 900′, but is developed mainly by tunnels, giving cheap mining costs. Values are apparently somewhat lessened below the seventh level, but the vein is strong and likely to carry workable values to great depth. The ore reserves are very extensive and are probably not less than 1,500,000 tons, divided into approximately 1,250,000 tons of sulphide ore and 250,000 tons of low-grade oxidized ore. These reserves are sufficient for at least five or six years' operations, or even longer on the present basis of production, which will doubtless be increased. Late in 1902 a 2′ vein of galena carrying average values of 45% to 50% lead, a little gold and 10 oz. silver per ton, was cut on the Leonard fissure, at a depth of 900′, and arrangements are being made to stope this ore. The mine is equipped with necessary machinery and electric power, but owing to its operation by tunnels no very extensive mining plant is required. The mine is connected with the railroad by a 2-mile aerial tram.

The smelter is at Bingham Junction, 17 miles from the mine, and has 7 reverberatory furnaces, with roasters, converters and all other necessary equipment, being thoroughly modern throughout and having a daily capacity of 500 to 600 tons. The ores are practically self-fluxing and give clean slags. Cost of smelting is said to be under $3 per ton. Production was about 6,000,000 lbs. in 1900; 9,043,967 lbs. in 1901 and 11,135,040 lbs. in 1902. The 1901 output was secured from 167,823 tons of ore smelted, giving average returns of 2.68% copper, while the 1902 output was obtained from 151,756 tons of ore smelted, giving average returns of 3.66%. It is said, apparently with truth, that the ore smelted was running better than 4.5% copper at the close of 1902, gold and silver values increasing or decreasing with the percentage of copper, having been larger in 1902 than in 1901, when the values were a scant $2 in gold and 1½ oz. silver per ton, or about $2.50 per ton average gross values in the precious metals. The output of August, 1902, was 1,386,000 lbs. of refined copper, and in the second week of December, 1902, the output was about 350,000 lbs., of blister copper. The present capacity of the mine and smelter may be estimated at 12,000,000 to 16,000,000 lbs. yearly, according to the grade of ore treated. Net earnings of the Highland Boy Mining Co. for 1902 were about $725,000, or 6.5 cents per lb. on the output, showing an actual cost of about 4.5 cents per pound for the copper produced, deducting gold and silver values from the cost of making. Mining and miscellaneous costs are estimated at $2.50 per ton and smelting and refining charges at $2.75 per ton, giving a total gross charge of $5.25 per ton. The Utah is a very valuable property. It is not one of the largest, but it is certainly one of the best of copper mines.

**UTAH & BOSTON COPPER CO.** **UTAH.**

Property sold to pay debts.

**UTAH & EASTERN COPPER CO.** **UTAH.**

Office: First National Bank, New Haven, Conn. Mine office: St. George, Washington Co., Utah. Employs 100 men. Organized 1901, under laws of Virginia, with capitalization $1,500,000, shares $5 par. Chas. E. Graham, president; W. G. Bushnell, vice-president; Louis E. Stoddard, secretary and treasurer; preceding officers, Darwin Almy and Judge Aldrich, directors; Grant Snyder, general manager; B. P. Wulfensten, smelter superintendent; S. E. Robbins, mining engineer. Lands, 11 patented claims, area 250 acres, also 40-acre smelter site, in the Tutsagubet district of Washington Co., showing 5 fissure veins, all of which are being developed, these having average width of 40′ and giving average assays of 15% copper, from oxide and carbonate ores. A blind shaft, 700′ deep, is sunk from the breast of a tunnel 225′ long, giving extreme depth of 900′ from surface. Has 100,000 tons of ore blocked out for stoping. Has 2 gasoline hoists and other necessary mining machinery. The lands include the old Dixie mine, which has been a considerable producer in a small way. The old smelter was located some distance from the mines and was blown out in 1902. Product was turned out as blister copper 98.2% in tenor. A new smelter being built nearer the mine will have a 50-ton furnace and other necessary machinery, and will probably be completed in 1903. Production for 1902 is estimated by company at 500,000 lbs.

**UTAH QUEEN MINE.** **UTAH.**

At Bingham Canyon, Salt Lake Co., Utah. Morris R. Hunt, manager. No returns secured.

**VAL CASTRUCCIO MINES.** **ITALY.**

Near Massa Maritima, Grosseto, Italy; no returns secured.

**VAL D' ELSA COPPER CO., LTD.** **ITALY.**

Offices: 122, Wellington St., Glasgow, Scotland. J. McFarland, chairman; J. Morton, secretary. Capital, nominal, £75,000. Lands, 12 square miles, near Gambarri, Val D'Elsa, Italy, held on 6% royalty.

**VAL VERDE COPPER CO., LTD.** **ARIZONA.**

Office and mine: Val Verde, Yavapai Co., Ariz. Organized 1899, under laws of Arizona, with capitalization $600,000, shares $5 par. M. F. Murphy, president; John L. Davis, secretary and treasurer; Cecil G. Fennell, general manager; S. E. Bretherton, superintendent; M. F. Murphy, Maurice Goldwater, H. Hawkins, Cecil G. Fennell, S. E. Bretherton, John L. Davis and W. F. Taylor, directors. Lands, 80 acres, in the Francis district of Coconino Co., Ariz., also 600 acres miscellaneous lands. Has 4 shafts, deepest, 200', and about 2,000' of underground openings, showing carbonate ore of good assay value, in lenses. Has extensive reduction works at Val Verde, on the Agua Fria river, 15 miles west of Prescott. Ores are sulphide and require silicious fluxes. Has a 100-ton furnace, also 10-stamp mill for free milling ore. Company owns the townsite of Val Verde, also a short railroad line, waterworks, etc. Company was practically reorganized in 1902, and new management is composed of men of experience and excellent financial standing.

**VALENCIA COPPER MINING CO.** **ARIZONA.**

Office: Hayward Bldg., San Francisco, Cal. Mine office: Sherwood, Trinity Co., Cal. Organized under laws of Arizona, with capitalization $1,000,000, shares $1 par. Chas. E. Laumeister, president; C. E. McDonald, vice-president; J. E. Manning, secretary and treasurer; F. P. Burris, superintendent. Lands, 12 copper claims, area 248 acrès, also 3 quartz gold claims, area 60 acres, and 250 acres of placer gold claims. Copper claims carry a gossan capping traceable more than a mile, and the auriferous quartz veins can furnish the necessary silicious fluxes. Property is well timbered, and fuel fairly cheap. A railroad now being built will give transportation facilities. Development is by 2 tunnels, which cut the main ore body at 3,000'. Company has extensive water rights, including 2 waterfalls of about 150' each.

**SOCIEDAD VALENCIANO-ANDALUZA.** **SPAIN.**

Office: Glorieta 1, Valencia, Spain. Don Nordal Preus, manager. Was developing copper and iron mining property near Penaflor, Sevilla, Spain, at last accounts.

**VALENZUELA MINE.** **ARIZONA.**

At Quartzite, Pima Co., Ariz. Supposed to have been sold to St. Louis and Chicago people who contemplate extensive development work and erection of a 100-ton smelter. No returns secured.

**VALLEY MINING CO.** **COLORADO.**

Mine office: Silver Cliff, Custer Co., Colo. H. M. Barry, superintendent.

Has copper-gold-silver-lead ores and is equipped with steam power. Employed about 30 men at last accounts.

**VALLEY VIEW MINING CO.** **CALIFORNIA.**

Office: San Francisco, Cal. Property, 90 acres, patented, 6 miles north of Lincoln, Placer Co., Cal. Vein matter is 250′ wide, with about 25′ of ore, between walls of schistose rocks. Has three shafts, deepest 130′, also a tunnel. There is a gossan outcrop nearly 100′ wide, for more than 1,000′ along the vein, this outcrop being argentiferous and auriferous, averaging $4 per ton in value, and has been worked as a gold mine. Ore shipments have averaged about 5% copper. Has two 5′ Huntington mills.

**VALLEY VIEW MINING CO.** **MONTANA.**

Has a copper-gold prospect about 2 miles south of Anaconda, Montana.

**VAN ANDA MINES & SMELTER.** **BRITISH COLUMBIA.**

Office and mines: Van Anda, Texada Island, B. C. Employs 60 men. T. J. Vaughan-Rhys, general manager. Is operated by a private syndicate, which took over the property from the Van Anda Copper & Gold Co., Ltd., in July, 1902. Lands, 20 claims, area 840 acres, in the Nanaimo district of British Columbia, including the Copper Queen and Cornell mines and adjoining claims. Estimated average value of ore is 8% copper, $1 gold and 2.5 oz. silver, per ton, secured from bornite and chalcopyrite. Has 4 shafts of 80′, 150′, 460′ and 500′, with tunnels aggregating 4,000′ and about 12,000′ of underground openings. Has steam plant, including 3 hoists, 5-drill Rand compressor, 5 pumps and power drills. Has a sawmill with daily capacity of 20,000′, also substantial wharf and warehouse.

Smelter is about one mile from the mines, receiving ore by tramway. Equipment includes a 75-ton rectangular furnace and a 50-ton circular furnace. Latter will be discarded and replaced by a 100-ton rectangular furnace. Reduction plant has complete sampling works, crushers, 2 blowing engines, etc., and turns out its production as matte averaging 50 to 55% copper, which is shipped east for electrolytic refining. Production was 1,127,533 lbs. refined copper in 1900 and is supposed to have materially increased in 1902. Operators will make extensive developments on the Cornell and Copper Queen mines and install a new hoist in 1903, in addition to increasing the smelting capacity.

**VANCOUVER & BOUNDARY DEVELOPMENT & MINING CO.** **BRITISH COLUMBIA.**

Mine office: Penticton, Yale & Cariboo district, B. C. C. Vacher, manager. Ores carry gold, silver and copper. Development is by shafts and tunnels. Has steam power, and employed 50 men at last accounts.

**VELARDENA MINING & SMELTING CO.** **MEXICO.**

An important property at Velardena, Durango, Mex., and a considerable producer from copper, silver and lead ores. Henry Payne Whitney, president; Carlos Wilhelmj, general manager; M. Dahlgren, mine superintendent; Wm. Daly, smelter superintendent. Mine and works are equipped with steam and electric power and smelter is of 250 tons daily capacity. Mine employs about 1,000 men. Property is regarded as exceptionally promising.

**VENTURE HILL MINING CO.** **ARIZONA.**

Office and mines: Jerome, Yavapai Co., Ariz. Employs 6 men. Organized 1900, under laws of Arizona, with capitalization $3,000,000, shares $1 par. Thos. E. Campbell, president and general manager; Geo. H. Avery, vice-president and superintendent; Chas. F. Avery, secretary; Frank E. Jordan, treasurer; preceding officers , C. T. Jolly, J. W. Avery and T. M. Elder, directors. Lands, 6 patented claims, area 110 acres, in the Verde district of Yavapai Co., showing 2 fissure veins, estimated, by company to have average width of 90′ and average values of 4.7% copper, $4 gold and 6.5 oz. silver per ton. Oxide ores in the upper and sulphide ores in the lower levels. Has shafts of 65′ and 87′, and tunnels of 205′ and 457′. Will continue development work during 1903.

**VERDE CONSOLIDATED COPPER CO.** **ARIZONA.**

Office and mine: Jerome, Yavapai Co., Ariz. Capitalization $1,500,000, shares $1 par. Jacob Marks, president; E. E. McFarland, secretary, at last accounts. No returns secured.

**VERDE MINING & MILLING CO.** **WYOMING.**

Office: 523 Bee Bldg., Omaha, Neb. Mine office: Battle, Carbon Co., Wyo. Organized 1900, under laws of Wyoming, with capitalization $1,500,000, shares $1 par. C. M. Jaques, president; Geo. H. Lyons, vice-president; J. E. Thatcher, secretary and treasurer; J. F. Hinton, general manager. Lands, 4 claims, patents pending, area 80 acres. Is developing a fissure vein averaging 35′ width and assaying 5% to 21% copper, $5 gold and 6 oz. silver per ton, from chalcopyrite, bornite and malachite. Has steam power and three shafts, deepest 70′.

**VERDE APEX COPPER MINING CO.** **ARIZONA.**

Office: 66 Broadway, New York. Mine office: Jerome, Yavapai Co., Ariz. Organized 1900, with capitalization $3,000,000, shares $1 par. John G. McBride, president and treasurer; Avery McDougall, secretary. Lands, 6 claims, area about 90 acres, in Mescal Gulch, about a mile southwest of Jerome. Was developing by shafts and tunnels at last accounts.

**VERDE CHIEF MINING CO.** **ARIZONA.**

Office: 1506-20 Broad St., New York. Mine office: Jerome, Yavapai Co., Ariz. Organized under laws of Arizona, with capitalization $3,000,000, shares $1 par. Dr. Clarendon A. Foster, president; John Gerken, vice-president; Henry T. Rogers, secretary; L. C. Haynes, treasurer; C. H. Akers, superintendent. Lands, 10 claims, area 200 acres, about 7 miles south of Jerome, Yavapai Co. Has about 1,700′ of underground openings. Company is understood to contemplate installation of a 100-ton reduction plant.

**VERDE GRANDE COPPER CO.** **MEXICO.**

Offices: 308 North Sixth St., St. Louis, Mo., and Phoenix, Ariz. Mine office: Hermosillo, Sonora, Mexico. Employs 50 to 100 men. Organized 1901, under laws of Arizona, with capitalization $2,500,000, shares $5 par. Has no bonded or other indebtedness. G. C. Campbell, president; Benj. Klein, vice-president; Geo. H. Martin, secretary; H. A. Leovy, treasurer; D. F. Hulbert, J. D. Fresh, H. C. Adams, Dr. W. H. Pontius, B. B. Hulbert,

R. P. Serrano and Jas. L. Zimmerman, directors; Jairus D. Fresh, general manager; Jas. Penman, superintendent; H. C. Erman, mining engineer.

Lands, 737 acres, 460 acres patented, in the Hermosillo district of Mexico, about 25 miles northwest of Hermosillo and about 60 miles south of the Greene Consolidated, lying some 3,000′ above sea level, in an equable climate and timbered with ironwood, cottonwood and mesquit. Water is scarce on surface, but can be developed readily by comparatively shallow wells. The main tract, of 460 acres, includes the Verde Grande, La Verde, La Cobriza and San Luis groups. The unpatented tract of 277 acres contains the Hermosillo and El Bajio groups, undeveloped but showing good outcrops. The Verde Grande group has a very large ore body, occurring in limestone the formation being a secondary eruptive, geological conditions favoring the existence of extensive ore bodies at depth. The ore is in a mountain and can be cheaply extracted by tunnels. Assays give 5% to 15% copper, $7 to $16 gold and 21 oz. to 42 oz. silver per ton.

La Verde and La Cobriza groups show a contact vein between granite and quartz, the ore having a gangue of talcose limestone, interstratified with lenses of granite and quartz. This contact vein is 30′ to 60′ wide and has been traced about 7,000′, having a strike approximately southeast and northwest, with frequent promising outcrops. Assays give 5.5% to 16% copper, $4 to $184 gold and 34 to 800 oz. silver per ton. Sixteen different openings have been made on La Verde Grande and La Cobriza groups, all said to show good values, developing about 50,000 tons of ore by about 2,000′ of underground openings.

An Allis-Chalmers furnace of 100 tons daily capacity is now being erected, and is to be blown in about May 1, 1903. The smelter is being built with a view to eventually increasing its capacity to 500 tons, and will include a 500-ton sampling mill. A 90′ well gives adequate water supply for boilers and smelter. Coke costs $25 to $30 per ton, Mexican, but wood can be bought for $4 per cord, Mexican, and though not of the best quality is much the cheaper fuel. Wages are $1.25 per day, Mexican, for native miners. The directors of this company are men of high standing and the property is one of merit.

**EL VERDE GRANDE COPPER CO. OF NOGALES. MEXICO.**

Also known as La Verde Grande and The Verde Grande. Was in litigation with the Verde Grande Copper Co. over the right to use the name, at last accounts. Property supposed to be in Mexico, but address of mines or company's office not secured.

**VERDE KING COPPER CO. ARIZONA.**

Office: 401 Henne Bldg., Los Angeles, Cal. Mine office: Jerome, Yavapai Co., Ariz. Organized 1900, under laws of Arizona, with capitalization $1,000,000, shares $1 par. Chas. J. George, president; Elmer C. Chapman, vice-president; Baron W. Riley, secretary; Melvin C. Nichols, treasurer; John Gray, superintendent. Lands, 17 patented claims, area 140 acres, not far from the United Verde mine, in the Jerome district of Yavapai Co. Is sinking shaft and driving tunnel. Has about 3,000′ of underground openings. Ores have assayed 11.5% to 24.5% copper. Company has no in-the adit to the third level considerable barrel work and good stamp rock was found in what was the footwall of the old mine. No. 2 is 8x12' inside measurement, with two compartments, and was 1,500' deep in November, 1902. Levels below the fourth are opened 100' apart. The lode was only 4' wide near surface, but at about 1,000' depth has an extreme width of 37'. The formation is much disturbed near surface, and the lode is irregular in dip, but with the widening at depth more regular walls are noted, as well as a considerable increase in copper. From the 7th level downward some very good stoping ground is shown. Old No. 1 shaft, 240' east of No. 2, is 188' deep; No. 3 is 350' deep and No. 4 is 180' deep. Sixteen levels have been opened and on Nov. 1, 1902, the mine had 20,075' of underground openings.

In addition to the Forest lode there are numerous other cupriferous beds. A crosscut sent 700' north from the main workings has shown nothing of value but the southern crosscuts have penetrated a number of cupriferous amygdaloids. The principal southern crosscuts on the footwall, include 2 on the first level, between shafts Nos. 1 and 2 and between Nos. 2 and 3; on the second level a crosscut was driven near No. 1 shaft and another between shafts Nos. 1 and 2; there are three on the third level, near No. 2 shaft, between Nos. 2 and 3 and near No. 4; three on the 4th level, one near No. 1 shaft, one near No. 2, 1 between Nos. 3 and 4, and one crosscut on the 10th level. The Forest conglomerate had an average width of 50' where cut. The footwall crosscuts show an underlying amygdaloid only 6' from the Forest lode. This epidotal amygdaloid is well mineralized for 4' or 5' along the footwall and has produced small masses up to 50 lbs. weight, the copper occurring mainly on the foot, with the epidote principally on the hanging wall. Underlying this epidotal lode some 60' is a 6' mygdaloid which shows much epidote and allied minerals and some stamp rock. An exploring shaft was sunk about 40' on an amygdaloid outcrop, about 200' south of the Forest lode. This gave a little copper, but nothing of much promise. An amygdaloid, called the Glenn, was opened in 1900 and gave a fair showing of copper at the bottom of a shallow shaft. A crosscut is to be sent through the entire formation from the bottom of No. 2 shaft, at the depth of 1,500'. Diamond drill borings have been made in various strata north of the mine openings, without locating anything of especial promise.

No. 2, the main shaft, has a frame shafthouse 32x34' with ell 16x36' and is 45' high. The engine and boiler house is 24x58' with an ell 24x28', of wood on stone foundations, with steel roof. The hoist has 12x28" cylinders and drum of 5' diameter with face of 6' 9". There are two 125-h. p. boilers, also a portable boiler and two 12-drill air compressors, operating 20 power drills. Two new and powerful permanent hoists will be added in 1903 for the regular use of the mine and a new air compressor will be installed. The property is heavily timbered and wood is used for fuel. The company owns a complete diamond drill outfit.

The combination carpenter shop and warehouse is 24x72'; frame blacksmith shop and machine shop is 20x52', with wings 8x30'; a frame boarding house and office, 2 stories high, is 27x64', with ell 10x37'. There is a frame schoolhouse, 19x41′, a stone dry for miners and about 60 dwellings for employes. A storage cistern 10x16x28′ holds water from the mine for feeding boilers, and water for domestic uses and fire protection is pumped from a well by a steel windmill having storage tank and 750′ of water mains. There is a sawmill with 56″ circular saw which furnishes timber and lumber for the mine's requirements.

The company plans building a one stamp mill, which can be increased in capacity when required. Rails are on the ground for a 6,000′ narrow-gauge railway to connect mine and millsite. This road will probably be operated by electric power. The nearest railway is the Chicago, Milwaukee & St. Paul, at Rockland, 3 miles distant. There is an inexhaustable supply of good building stone on the company's lands. This is of fine grain and good strength, and is easily quarried in large blocks. It has been suggested that an adit be run from the river bank into the mine, on the 7th level, which would permit very cheap extraction of ore.

The Victoria has a big water power at Glenn Falls, on the west branch of the Ontonagon river, about one mile from the mine. The stream drops 73′ in three-quarters of a mile and nearly 150′ in one and a half miles, by a series of small falls, between which are numerous rapids with sandstone bottoms. An offer of $100,000 for this water power has been refused. This is much the best natural water power of the Lake Superior district and is being extensively developed by a dam and canal. The dam was built in 1902, of steel and concrete, from excavation to sandstone bed-rock, hence cannot be undermined by water. The dam is 320′ feet between abutments and has 32 eighteen-inch "I" beams, 10′ apart, sunk vertically 5′ to 10′ in bed-rock, with cement filling. The dam has an extreme height of 24′ with width of 14′ at the bottom and 8′ at the top, with a 320′ main section and wings of 100′ and 160′, a total length of 580′, built with an arch up-stream, giving very great strength. The dam is faced on the water side with 3-16″ steel plates, 5x10′ in size, bolted to the steel "I" beams through the concrete. The center of the dam has an apron 80′ wide, also a floating boom to guide logs, as the stream is used extensively for logging operations. The dam is so substantially built that it cannot be torn out by a log-jam. The outlet is a 44″ steel pipe, leading from the bottom of the dam to the power canal.

The canal diverting water from the dam is nearly 6,000′ in length, running about 2,000′ through sandstone and 4,000′ in alluvium. The canal is 50′ wide at the top, 20′ wide at the bottom and 12′ deep. The outlet of the canal has 6 gates, in 2 sets, separated by a heavy concrete abutment. The gateways are made of 20″ "I" beams set vertically, 6′ apart, with 6 gates of heavy oak planking, worked vertically by rack and pinion actuated by water power. It is not fully decided whether this water power will be utilized for running air compressors or electric dynamos, but it is possible that both electricity and compressed air will be utilized, as each offers certain marked advantages for the various underground and surface uses to which power will be applied. The canal is to be completed in 1903, and will immediately develop at least 5,000 h. p., with a possibility of eventually developing some 20,000 h. p.

The Victoria has been managed both prudently and energetically, and no Lake Superior mine has secured better value for each dollar expended. The company sustained a great loss in the death of the late Gov. Thos. B Dunstan, but is in capable hands, and development will be continued along the true and sound lines originally planned.

**VICTORIA COPPER MINING CO.** **UTAH.**

Was operating near Ashley, Uintah Co., Utah several years ago. No returns secured.

**FELIX VICUNA.** **CHILE.**

Address: Higuera, Serena, Chile. Operates the Higuera mine, opened in 1855, producing 800 to 1,000 tons of refined copper yearly. Same owner has the Solitaria mine, 130′ deep, opened in 1893; the Panchita, 350′ deep, opened in 1850, and the San Ramon, 270′ deep and opened in 1851, the three latter properties having been idle at last accounts.

**SANTIAGO VICUNA.** **CHILE.**

Operates the Astilleros and El Jirio mines. The former, in the department of Huasco, Chile, was opened in 1890 and has an annual output of about 500 tons, shipped as bars. El Jirio mine, opened in 1896, is in the department of Freirina, Chile, and produces about 1,000 tons of copper yearly.

**VIELLA COPPER CO., LTD.** **SPAIN.**

Offices: Broad St. Ave., London, E. C., Eng. H. Ellis, chairman; Don Jose E. de Olano, local director; H. Stone, secretary. Capital, nominal, £100,000. Lands, area 340 acres, are nine miles from Viella, Huesca, Spain, and are held on perpetual lease from the Spanish government, subject to an annual tax of about £30.

**VIGSNES KOBBERVAERKS AKTIEBOLAG.** **NORWAY.**

Office: Talbodgaden 8B, Christiania, Norway. Was the principal copper producer of Norway for some years, but has been idle since circa 1894.

**VILLAGE BELLE GOLD & COPPER CO.** **COLORADO.**

Has 40 acres of ground near North Park, Routt Co., Colo., and was doing a little development work at last accounts.

**VIOLA GOLD & COPPER MINING CO.** **WASHINGTON.**

Address: care of Archibald McNicoll & Co., 276 West Broadway, New York.

**VIRGIN MINE.** **ARIZONA.**

Near Dewey, Yavapai Co., Ariz. Wm. Baker, owner. A prospect, from which no returns have been secured.

**VIRGINIA COPPER CO., LTD.** **VIRGINIA.**

Office: 99 Cedar St., New York. English office: 95, Gresham St., London, E. C., Eng. Mine office: Highhill, Halifax Co., Va. Capitalization $1,500,000. Senator C. P. Vedder, president; F. M. Davis, vice-president; Jas. B. Van Woert, secretary and treasurer; Evan Davies, superintendent. Lands, 617 acres, in Halifax Co. Property is the Highhill mine, north of Virgilina, opened about 1897. Has 8 shafts, 140′ to 300′ deep. Is developing ore assaying up to 5.9% copper, 80 cents gold and 2 oz. silver per ton. Has 350-h. p. machinery plant, including concentrator, and reduces ores 11 into 1, concentrates being shipped to New York and Norfolk, Va., for smelting.

**VIRGINIA CONSOLIDATED COPPER CO.** **VIRGINIA.**

Office: McKeesport, Pa. Thos. A. Dunshee, general superintendent; W. Harry Hamilton, president; J. M. Mackintosh, secretary. Organized under laws of New Jersey, with capitalization $1,000,000. Property is near Luray, Va. Has a shaft about 150′ deep, which is to be continued to depth of 500′. Has steam power and air compressor. No returns secured.

**VIRGINIA BELLE GOLD & COPPER MINING CO.** **ARIZONA.**

Office: 13 South Seventh St., Minneapolis, Minn. Mine office: Vail, Pima Co., Ariz. Organized 1902, under laws of Arizona, with capitalization $1,500,000, shares $1 par, with 700,000 shares in treasury. W. W. Huntington, president; S. F. Finkelson, vice-president; C. F. Potter, Jr., secretary; C. F. Potter, treasurer; Jas. H. Bennett, general manager at mine. Lands, 8 claims, area 160 acres, also 40-acre mill and smelter site, in the Lincoln district of Pima Co. Mineral zone is apparently 600′ to 800′ wide and about 1,500′ long. Each claim has prospect shafts in ore assaying 5% to 35% copper and $22 to $28 gold and silver per ton. Deepest shaft, 123′. Steam plant is to be installed in 1903, and company expects to push development work vigorously.

**VITA RICA COPPER MINING CO.**

Incorporated under laws of Maine, with six directors. No trace found of company's address or mining property.

**J. D. VORIS COPPER MINING CO.** **COLORADO.**

Was prospecting near Hillside, Fremont Co., Colorado, at last accounts. No returns secured.

**VULCAN CONSOLIDATED COPPER CO.** **NEVADA.**

Office: 35 Nassau St., New York. Mine office: Siegelton, Esmerelda Co., Nev. Organized 1899, as Vulcan Copper Mining & Smelting Co., and reorganized 1901, under laws of West Virginia, with present title. Capitalization, $5,000,000 authorized and $3,000,000 issued, shares $10 par. Annual meeting, second Tuesday in February. Chas. T. Champion, president and general manager; Jos. Siegel, first vice-president; John R. Butler, second vice-president; Ambrose I. Harrison, secretary and treasurer; preceding officers, Frank L. Fisher, Frank Champion and Frank B. Taylor, directors; Newton A. Duncan, superintendent. Lands, 49 claims, area 980 acres, also 3 millsites, in the Sodaville or Santa Fe district of Esmerelda Co. Has about 7,000′ of shafts and tunnels and has expended about $250,000 in prospecting and developing. Has about 60,000 tons of ore in sight, assaying 2.7% to 4% copper, with gold and silver values of 75 cents to $1 per ton. Has a small smelter, which is idle, and has been experimenting with a leaching process. Company understood to be badly in need of funds for further development.

**VULCAN COPPER MINING CO.** **WYOMING.**

Office: Wausau, Wis. Mine office: Encampment, Carbon Co., Wyo.

Organized 1898, with capitalization $1,000,000, shares $1 par. W. H. Monroe, president: W. D. Kolloch, secretary; F. J. Lordier, superintendent. Lands, 120 acres, in the Encampment and Battle Lake districts of Carbon Co. Has 3 shafts, deepest 100′ at last accounts, with 15′ vein of sulphide ore. Is in litigation with the Battle Lake Consolidated Copper Co. over title to nearly all of the lands claimed by the Vulcan Co.

**WABASH MINING CO.** **CALIFORNIA.**

Office: Los Angeles, Cal. Mine office: Letcher, Fresno Co., Cal. Dr. J. H. Bryant, president. Lands, 16 claims, adjoining the Copper King, at Letcher. Has 2 shallow shafts and tunnels of 400′ and 300′. Complete steam and compressed air outfit installed in 1902. No returns secured.

**WAGNER-GREEN MINING & MILLING CO.** **WYOMING.**

Office: Pearl, Larimer Co., Colo. Property supposed to be in Carbon Co., Wyo. No returns secured.

**WAHNITA COPPER MINING CO.** **MICHIGAN.**

A fraud: company out of existence and stock worthless.

**WALDO COPPER MINES CO.** **OREGON.**

See Waldo Smelting & Mining Co.

**WALDO SMELTING & MINING CO.** **OREGON.**

Office: Mills Bldg., San Francisco, Cal. Mine office: Takilma, Josephine Co., Ore. Employs 75 men. Organized 1901, under laws of Colorado, with capitalization $3,000,000, shares $100 par. Jas. O'B. Gunn, president; Chas. L. Tutt, vice-president; Chas. McNeil, secretary; Spencer Penrose, treasurer; T. Waln-Morgan Draper, general manager; preceding officers and John Barth, directors; A. C. Fulmer, superintendent. Lands, 32 claims, 9 patented, area 900 acres, also 650 acres miscellaneous lands, including 160-acre millsite and 120-acre smelter site, in the Waldo district of Josephine Co., showing 5 fissure veins with average width of 12′ and estimated average values of 12% copper, trace of silver and $4.50 gold per ton. Ore, mainly sulphide, with a little oxide and carbonate. Has 5 shafts, 100′ to 300′ deep, and 15 tunnels, from 150′ to 1,200′ long, with about two miles of underground openings. Estimated ore in sight, 100,000 tons; blocked out for stoping, 40,000. Has water power, developed by hydraulic wheels, also steam pumps, hoists, etc. Has a 50-ton Fraser & Chalmers blast furnace, at the mine, product being turned out as 40% matte. Nearest railway is the Southern Pacific, 40 miles distant. Will continue underground development and add to surface equipment in 1903.

**WALL MINE.** **VIRGINIA.**

Near Virgilina, Va. Was a small shipper in 1900; no returns secured for later years.

**WALL STREET MINE.** **NEVADA.**

At Luning, Esmerelda, Co., Nev. A. S. Lawrie, superintendent. Was developing by tunnel, with small force at last accounts.

**WALLAROO & MOONTA MINING & SMELTING CO.** **AUSTRALIA.**

Offices: Grenfell St., Adelaide, South Australia. D. Davidson, secretary. Principal mine office: Wallaroo, Yorke Peninsula, South Australia.

Employs a large force. Property includes 2 separate mines, 10 miles apart. The Wallaroo was opened about 1860 and has 6 veins, widest 14′. Mine has 20 miles of underground openings. Deepest shaft is 1,620′. Ore mainly chalcopyrite, returning 3% to 10% copper. The Moonta mine is 10 miles south of the Wallaroo and has 5 main and 22 minor veins, with 77 shafts and 30 miles of underground openings. The ore is of very low grade, averaging only about 1.5% copper, and the metal is secured by leaching the roasted ores with sea water and dilute sulphuric acid, and precipitating cement copper from the leach water in tanks. Company is now leaching about one million tons of tailings from the Moonta, with sea-water and acid. The deepest shaft of the Moonta is down nearly one-half mile, and cost of copper from this property is said to be about 10½ cents per pound. Ore is mainly chalcopyrite, in a fissure traversing porphyry, considerable native copper being found in the vein. Annual production of the company is about 15,000,000 lbs.

**WANDILITA COPPER MINES, LTD. AUSTRAILA.**

Offices: 30, Moorgate St., London, E. C., Eng. A. S. Caine, chairman; J. A. Russell, secretary. Capital, nominal, £120,000. Lands, 140 acres at Kadina, near Port Wallaroo, Yorke Peninsula, South Australia, held on 42-year lease from 1899 at a royalty of 2.5% net profits.

**WAR EAGLE MINE. BRITISH COLUMBIA.**

Mine office: Rossland, B. C. E. B. Kirby, general manager. Is primarily a gold-silver-lead mine, but secures considerable copper as a by-product. Ores treated in 1901 averaged about $16 gold, 1 oz. silver and 2.1% copper, production of copper for the year being about 750,000 lbs.

**WARRA WARRA MINE. AUSTRALIA.**

Address: care of F. Stevens, Grenfell St., Adelaide, South Australia. Was working in a small way at last accounts.

**WASHINGTON MINE. CALIFORNIA.**

In Sections 30, 31 and 32, Town 2 South, Range 15 East, Tuolumne Co., Cal. Owned by W. E. & G. A. Hensley. Was formerly a considerable producer. Vein formation is diabase and metadiabase. A little prospecting work was in progress at last accounts.

**WASHINGTON MINING CO. MICHIGAN.**

Office: 60 State St., Boston, Mass. H. F. Fay, president; Jas. Chynoweth, superintendent. Lands, 800 acres, on western shore of Mosquito Lake, Keweenaw Co., Mich. Capitalized at $2,500,000, shares $25 par; 40,000 shares unissued. Last exploratory work was done in 1900. Cash on hand January 1st, 1902, was $4,394.

**WASHINGTON CO-OPERATIVE MINING SYNDICATE. WASHINGTON.**

Owns the East Lake and Tacoma claims, latter 17 miles by pack trail southeast of Fairfax, Wash. Vein is about 25′ wide, carrying disseminated chalcopyrite, with rich 3′ pay-streak on footwall. Ores assay 5% to 33% copper, 5 to 8 oz. silver and $2 gold per ton. Has water power. Company also owns a coal mine at Fairfax and contemplates building a smelter there.

**WASHINGTON-SONORA GOLD & COPPER CO.** **MEXICO.**

Office: Nogales, Ariz. Employs 25 men. Organized 1902, under laws of Arizona, with capitalization $2,500,000, shares $5 par. A. L. Lewis, president; Dr. A. J. McCallum, vice-president; Percy Sharpe, secretary and general manager; A. Sandoval, treasurer; preceding officers, Geo. A. Lonsberry and F. Oleson, directors; A. H. Hoover, superintendent. Lands, 4 patented claims, in the Magdalena district of Sonora, Mexico, showing fissure veins and lenses in limestone, all apparently of good size, with estimated values of 18% copper, $4 gold and 12 oz. silver per ton, from carbonate and oxide ores, with some native copper. Has 4 shafts, deepest about 20′, also 2 tunnels, now driving. Smelter site is at Puerto, on Sonora railroad, 3 miles from mine. Company contemplates continuing development work and installing a mining plant in 1903.

**WASHOE COPPER CO.** **MONTANA.**

Office and mines: Butte, Silver Bow Co., Mont. Wm. Scallon, general manager; Wm. Skyrme, superintendent. Employs 200 to 300 men. Stock of company is controlled by the Amalgamated Copper Company. Principal mine is the Moonlight, having a 3-compartment shaft about one-quarter mile deep, and giving good copper and silver values. The Clear Grit mine, owned by this company, idle for some years, resumed work July, 1902.

**WAUKEGAN & WASHINGTON MINING & SMELTING CO.** **WASHINGTON.**

Mine office: Bossburg, Stevens Co., Wash. Jas. Moffatt, superintendent. Is developing gold-silver-copper ores on the Easter Sunday claim, with steam power and small force.

**WAYEHUTTA MINE.** **NORTH CAROLINA.**

Owned by Carolina Copper Co.

**NICOLAS WEBER.** **MEXICO.**

Name given by Mexican government as operator of a copper property near Mineral de Asientos, Aguascalientes, Mexico. No returns secured.

**WENTWORTH MINE.** **ARIZONA.**

Near Payson, Gila Co., Ariz. J. W. Wentworth, superintendent. Was opening gold-copper ores by shaft and tunnel at last accounts.

**WEST AUSTRALIAN MINING CO., LTD.** **AUSTRALIA.**

Offices: 257, Winchester House, London, E. C., Eng. E. Pope, chairman; J. Doyle, managing director; H. J. Dixon, secretary. Is a reorganization of the Victoria Copper Co., Ltd. Capital, nominal, £120,000. Company owns copper lands at Northampton, Western Australia, also mining tracts elsewhere.

**WEST CHILLAGOE MINES.** **AUSTRALIA.**

Worked about 20 men on copper properties in the Chillagoe district of Queensland previous to the closing down of the Chillagoe smelter.

**WEST FORK GOLD-COPPER MINING CO.** **IDAHO.**

M. E. Gallimore, president. J. W. Higgins, former secretary, writes that company is "very much at a standstill and cannot tell when they will get a move on." Company was promoted by the notorious L. E. Pike & Co.

**WESTMORELAND COPPER CO.** **NEW BRUNSWICK.**

Office: Dorchester, N. B. Said to have 7,000′ of underground openings, with concentrator, smelter and 80 precipitating tanks for copper leaching. Said to have expended $250,000 on mines and plant. No returns secured.

**WEST MOUNTAIN MINING CO. OF ARIZONA.** **UTAH.**

Office: Nashua, N. H. Capitalization $1,000,000, shares $1 par. Company's representative states that nothing is being done in the way of development, and that the corporation is seriously considering winding up its affairs. Property consists of a group of well located claims near Bingham Canyon, Salt Lake Co., Utah.

**WEST SIDE MINING CO.** **WASHINGTON.**

Letters to former address of company and to A. H. Winthrop, former secretary and treasurer, returned unclaimed from Seattle, October and December, 1902. Organized 1900, with capitalization $1,000,000, shares $1 par. David Kellogg, president and A. H. Winthrop, secretary and treasurer, at last accounts. Lands, 140 acres, near Berlin, King Co., Wash.

**WEST SLOPE COPPER MINING & MILLING CO.** **UTAH.**

Office: 627 Mining Exchange, Denver, Colo. Mine office: La Sal, Grand Co., Utah. Organized 1901, with capitalization $1,500,000, shares $1 par. W. W. Anderson, president; Gid. R. Propper, vice-president and general manager; M. L. Weber, secretary and treasurer. Lands, 240 acres, including 160 acres of placer claims, in the La Sal district of Grand Co. Had a 60′ tunnel and two shallow shafts at last accounts, with a 4′ vein of auriferous and argentiferous copper ore.

**WESTERN SLOPE COPPER MINING & SMELTING CO.** **COLORADO.**

Office: 38 Ames Bldg., Boston, Mass. Mine office: Grand Junction, Mesa Co., Colo. No returns secured.

**WHALE MINE.** **NEW MEXICO.**

Near Tres Piedras, Taos Co., N. M. A. Royal, superintendent, at last accounts.

**WHALEN CONSOLIDATED COPPER MINING CO.** **ARIZONA.**

Had an office in Chicago, 1901, and placed a little stock at fancy prices, Presumably dead, as no trace of company can be found.

**WHAT CHEER COPPER CO.** **WYOMING.**

Mine office: Riverside, Carbon Co., Wyo. O. S. Allers, superintendent. Was working small force at last accounts on prospects on Dunkard's Creek, near Riverside. Owners supposed to be mainly residents of Rhode Island.

**WHEALKATE COPPER MINING CO.** **MICHIGAN.**

Office: Houghton, Houghton Co., Mich. Organized November, 1902, under laws of Michigan, with capitalization $50,000. Lands, 240 acres, including Whealkate mine, but is primarily a townsite company. The "mine," which adjoins the Atlantic, was "opened" in 1851, and is possibly the best example extant of how not to do it. A shaft was sunk 40′ in trap rock; thence a drift was sent 20′ south; thence an incline shaft was sunk 50′;

thence a crosscut was driven 100′ to a copper lode, on which a drift was opened 50′ south, and at the end of this drift a winze was sunk 40′, giving openings on 6 different planes in 300′.

**WHIMWELL COPPER MINE, LTD.** **AUSTRALIA.**

Offices: 11, Ironmonger Lane, London, E. C., Eng. C. G. Tegetmeier, chairman; L. Downes, secretary. Capital, nominal, £150,000. Property, 260 acres, in Pilbarra field, Western Austrailia.

**WHIPSAW COPPER CO.**

Office: 35 Wall St., New York. No returns secured and location of property, if any, unknown.

**WHITE EAGLE COPPER MINING CO.** **TEXAS.**

Mine office: Burnett, Burnett Co., Texas, on east side of Colorado river. Ores are cuprite, malachite and azurite, in a quartz gangue. Developed by shaft and open cut. Has a 25-ton concentrating mill and at last accounts contemplated using a leaching process and cyaniding the tailings. No returns secured.

**WHITE HORSE MINING CO.** **ARIZONA.**

Office: 20 Broad St,. New York. Lands, 200 acres, in Yavapai Co. J. E. Conlee, superintendent. No returns secured.

**WHITE KNOB COPPER CO., LTD.** **IDAHO.**

Office: 36 Wall St., New York. Mine office: Mackay, Custer Co., Idaho. Originally organized under laws of West Virginia as White Knob Mining Co., with capitalization $5,000,000; reorganized under present title, Apr. 24, 1900, under laws of New Jersey, with capitalization $12,500,000, in 125,000 shares, par $100; on Jan. 6, 1903, arranged to reorganize again, under same charter and title, with capitalization $1 750,000, in 175,000 shares, par $10, with an issue of 50,000 shares of new stock, presumably to be used for securing additional funds. Has an authorized bond issue of $500,000, in 10-year $1,000 sinking-fund 6% gold bonds, redeemable at 115 and accrued interest any year after 1904, with proviso that bonds are convertible into stock at the price of $12.50 per share. Bond issue said to be underwritten, probably with a bonus of new stock for the underwriters. Annual meeting, second Tuesday in January. Corporation Trust Co., 135 Broadway, New York, transfer agent. Henry J. Luce, president; Wilbur K. Matthews, vice-president; Chas. G. Funk, secretary; Chas. B. Van Nostrand, treasurer; Austin M. Poole, assistant secretary and treasurer; preceding officers, Wm. L. Stow, Edw. C. Platt, Edgar C. Bradley, Geo. J. Smith and Reginald Foster, directors. Wayne Darlington, who was in charge of the property as superintendent from the beginning of work, resigned with his entire staff in the spring of 1902 and was succeeded by S. F. Boyd. Apparently Mr. Boyd has since been replaced by Percy L. Fearn, consulting engineer, who seems to be in general charge. J. D. A. Smith was smelter superintendent at last accounts. Geo. R. Hancock, of Salt Lake City, was mine superintendent for 90 days during 1902, barring three weeks' lost time, while the mine was idle. Name of his successor not learned. Thos. Brown was electrical superintendent at last accounts.

Lands have a total area of about 2,100 acres, including 32 mining claims, 3 millsites, sundry water rights, timber lands and right of way for electric railway; also the 90-acre townsite of Mackay, all in the Lost River Valley of Custer County, Idaho. Mackay is a town of about 1,000 people, and the company has succeeded in selling nearly $50,000 worth of real estate for business and residence purposes.

The ore bodies of the mine are said to be extensive, but no detailed figures have been secured. Mine openings include a 700′ shaft and about 6 miles of tunnels, crosscuts and drifts. The mine is said to have large ore reserves and to give average values of 4% copper and $1.50 gold and silver per ton. The machinery plant is said to be extensive.

The mine is reached by a 96-mile branch of the Oregon Short Line railway, running from Blackfoot to Houston. To connect the mine and smelter the company has a 10-mile electric railway with maximum gradient of 6% in an elevation of 2,000′. At last accounts company was planning to re-lay this electric line with heavier rails. The smelter is said to have three 200-ton furnaces. It was blown in about September, 1902, and blown out again about a month later, ostensibly to await the completion of a 1,500′ tunnel to effect a junction with the bottom of a 700′ shaft. This tunnel was nearing completion at the close of 1902. The company has a water power, said to be valuable.

The policy of the White Knob company has been vacillating in the extreme. The property was to have begun production on a large scale some two years ago, but at the close of 1902 is still developing. Excuses for delays have been numerous, and the directors have blamed everybody but themselves for these delays. At the close of 1901 the reasons given for the failure of the company to make copper were the delay in the completion of the railroad line and the delay of the Allis-Chalmers company in furnishing the smelter. Changes in the local management have been both numerous, frequent and demoralizing. The mine and smelter were entirely closed June 26, 1902, and the rumor was abroad that the enterprise had been permanently abandoned. A later rumor was that the mine was closed to rid the property of undesirable labor. Work was resumed less than a month later, and shortly thereafter the smelter was blown in, only to be blown out again after a few weeks run. The future of the property will doubtless be determined by the results secured, in the fullness of time.

**WHITE ROCK COPPER KING MINING CO.** **CALIFORNIA.**

Office: Ellsworth, Me. Mine office: Lewis, Mariposa Co., Cal. Edwin L. Foster, superintendent. Lands, 320 acres, patented. Has heavy gossan outcrops with schistose diabase vein matter. Ore is sulphide at depth of 100 feet. Main shaft, 150′. Has 950′ of underground openings. Vein channel 100′ wide. Smelter shipments of 450 tons of oxide and carbonate ores in 1902 gave average returns of 20% copper, and $2 to $4 gold and silver per ton.

**WHITNEY REDUCTION CO.** **NORTH CAROLINA.**

Mine office: Gold Hill, Rowan Co., N. C. Is developing a gold mine just north of the Union Copper Co., and has promising copper ores on its lands.

**WILLIE BOY MINE.** **OREGON.**

At Comer, Grant Co., Ore. J. Reese, superintendent. Is developing a gold-silver-copper ore body, by tunnel, with small force.

**WIND FALL MINING CO.** **WASHINGTON.**

Mine office: Chewelah, Stevens Co., Wash. C. T. Rigg, superintendent. Ores show gold, silver, lead and copper.

**WINNIPEG MINING & SMELTING CO.** **BRITISH COLUMBIA.**

Mine office: Grand Forks, Yale & Cariboo district, B. C. Richard Plewman, manager. Has gold-silver-copper ores, opened by shaft. Has steam power, and employs about 25 men.

**WINONA COPPER CO.** **MICHIGAN.**

Office: 11 William St., New York. Mine office: Winona, Houghton Co., Mich. Organized 1898, under laws of Michigan, with capitalization $2,500,000, shares $25 par. Annual meeting, last Tuesday in March. Boston Safe Deposit & Trust Co., registrar; American Loan & Trust Co., of Boston, transfer agent. John Stanton, president; J. Wheeler Hardley, secretary; John R. Stanton, treasurer; John Stanton, Jos. E. Gay, Wm. A. Paine, John R. Stanton and Jas. H. Seager, directors; Frank McM. Stanton, superintendent; F. W. Denton, assistant superintendent; John Welton, mining captain; Wm. Van Orden, clerk.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $800,000.00 |
| Amount paid in by conveyance of property to company | 450,000.00 |
| Entire amount invested in real estate | 479,972.50 |
| Amount of personal estate | 11,537.36 |
| Amount of unsecured or floating debt | 21,154.49 |

Expenditures for 1901 were $48,352.33, leaving a deficit of $9,617.13, at close of the year.

Once regarded as among the most promising properties of the Lake Superior district, Winona fell in popular estimation until it was held to be practically worthless, even by those interested in its management, but within the past few months has again gained surprisingly in favor, owing to unexpectedly good results from an extensive mill test. The mine was first opened in 1864, by a single shallow shaft on an amygdaloid lode, from which mass copper was taken to the extent of several barrels. The lode was discovered by a line of prehistoric pits along the outcrop, the size of these pits indicating that considerable masses of copper had been secured therefrom by the olden miners. Owing to entire lack of transportation facilities, little work was done. The property was let on tribute in 1880, but did not furnish sufficient mass copper to pay the tributors and was soon dropped, to remain idle until taken over by the present company.

Lands are 1,568 acres, the main tract being 1,440 acres, with a smaller tract of 128 acres, also timber rights to 1,768 acres lying 3 to 5 miles south of the mine. The main tract of the Winona is in Sections 19, 20, 29 and 36, Town 52 North, Range 36 West. The Wyandot lies on the east and undeveloped land of St. Mary's Mineral Land Co. on the north, south and west. The main tract carries the outcrop of the Winona amygdaloid for upwards of a mile. Work was begun April, 1898, under great difficulties, transportation being over 26 miles of exceedingly bad wagon road. The old shaft was cut down, retimbered and deepened and 3 new shafts sunk, all on the Winona lode, an amygdaloid bed running 12′ to 35′ wide with a strike of about N. 59° E. and a dip of about 70°. The formation is much disturbed, although becoming more regular in the lower openings. In addition to sinking shafts, considerable diamond drill boring has been done. Search was made for an epidotal amygdaloid said to lie near the Winona bed, but no such lode was located. Other copper-bearing amygdaloids have been located, but with the exception of the Winona bed, none carry copper in promising quantities. The Winona amygdaloid carries considerable epidote, calcite and quartz. A limited amount of mass and barrel copper is found, but the bulk of the metal is in the stamp rock, and is found in nodules rather than flakes. It is doubtless owing to the copper coming in this unexpected form that the mill tests have shown the rock to be so much richer than was anticipated.

No 1 shaft, the discovery pit opened in 1864 and enlarged and deepened by the present company, is in the northeast quarter of the northwest quarter of Section 29, and is 8x18′ inside of timbers, with 3 compartments, carrying ladderway and pipes in the central section. The shaft is 400′ deep and has four levels opened. A little heavy copper and some stamp rock have been found in the northern drifts of this shaft.

No. 2, the principal shaft of the mine, is 900′ northeast of No.1, sunk at an angle of 72°, and was 575′ deep on Nov. 1, 1902, with 6 levels opened. On the fourth level about 1,500′ of drifting has been done, showing good copper ground for about 200′ only. The sixth or bottom level makes much the best showing of any part of the mine, having produced masses weighing up to 800 lbs., and a considerable proportion of the openings show excellent stamp rock. Two stopes were running on this level at the close of 1902. The lode is 16′ to 40′ in width on this level and the formation is much more regular than at any point above.

No. 3 shaft, now idle, is 900′ north of No. 2 and was sunk to about 750′ depth without opening any ground of especial promise. No. 4, the northernmost shaft, is about 1,350′ northeast of No. 1, and is sunk at an angle of 70°; this shaft is now idle, nothing of importance having been developed. No. 5 shaft was started on a wide amygdaloid, located by diamond drill, but as sinking did not develop good ground, was discontinued at little depth.

The Winona lode, as opened in the original shafts, made a very good showing for 50′ to 100′ below surface and then turned decidedly poor, but is again improving at depth. The mine had about two miles of underground openings at the close of 1902.

The engine house, located midway between shafts 1 and 2, is 40x40′, of steel frame on stone foundations, with corrugated iron siding and roof. The hoist has two 5′ drums, good for 800′ depth. This building contains a "Class A," two-stage straight-line Ingersoll-Sergeant 12-drill air compressor, also a smaller one-stage compressor. Adjoining is a boiler house, 40x48′, of steel on stone foundations, with iron siding and roof, housing four 80-h. p. boilers. The Winona has 15 power drills, 5 drills being in use at the close of 1902. Other mine buildings are a warehouse, 26x40′; carpenter shop, 20x40′; smithy, 22x34′; store building, 30x40′; office building; 2 boarding houses, 16 frame dwellings and 9 log houses, the dwellings being built in a townsite platted by the company. The Winona also has a sawmill 30x70′, with a wing 42x66′ for boilers and a second wing of 16x46′, the latter containing a shingle mill. The plant has a daily capacity of 20,000′ of sawed lumber. The main line of the Copper Range railroad passes near the mine and a spur has been built to No. 2 shaft.

Although the showing secured at the mine was not especially promising, it was decided by the management that a mill test should be made, in view of the years of labor and large sums expended on the property, consequently one stamp was secured at the Atlantic mill, which is the step-mother of the South Range mines. The returns from the rock milled were most surprising to all concerned, giving nearly double the amount of copper anticipated by the management and those most conversant with the property. For one week in December, 1902, returns were 55 pounds of mineral to the ton, equal to about 40 lbs. of refined copper, or 2%, which is a larger return than is being obtained by any amygdaloid mine of the Lake Superior district. This week's returns were the best secured, but the mine has yielded an average of 30 to 40 lbs. of mineral per ton, carrying from 20 to 30 lbs. of refined copper, with a net average of 23 lbs. ingot copper per ton. About 200 tons of rock are sent to the mill daily, and a larger tonnage could be stamped if it were possible to furnish it. The mine could supply the rock, but as it lacks a rock-house and permanent shipping facilities, the production is handled under considerable difficulties. The mine is working a force of 110 men at the close of 1902 and the present large output, secured so awkwardly, is practically paying running expenses.

It is yet too early to pronounce the Winona an assured success, but the results secured at the mill have surprised everyone, from the president of the company to the miners breaking the rock. The prospects of the mine are incomparably brighter than one year ago, and the property is giving such unexpectedly good returns that it will be afforded every opportunity of proving its real value.

**WINONA-REX COPPER MINING CO. WYOMING.**

Address: care of John Ludwig, president, Winona, Minn. Mine office: Encampment, Carbon Co., Wyo. Was working a small force at last accounts.

**WINTHROP MINE. MICHIGAN.**

Owned by L. C. Palmer, Marquette, Mich. Property, 800 acres in Keweenaw Co., Mich. Worked 1852-1860; since idle.

**WISCONSIN CLAIM.** **CALIFORNIA.**

At Darwin, Inyo Co., Cal. Chas. Richardson, owner. Has a contact vein between limestone and granite, 2′ to 6′ wide, with shaft of about 150′, showing cuprite, malachite and chalcopyrite. Was developing at last accounts.

**WISCONSIN-WYOMING COPPER MINING CO.** **WYOMING.**

Office: Probably La Crosse, Wis. Organized September, 1902, under laws of Wyoming, with capitalization $1,000,000. Wm. Ott, president; R. B. Gelatt, vice-president; W. E. Polleys, treasurer; John M. Verchota, secretary and general manager. Lands, 2 groups of claims near Hidden Treasure and Beulah properties, in Carbon Co., Wyo.

**WOLVERINE COPPER MINING CO.** **MICHIGAN.**

Office: 11-13 William St., New York. Mine office: Kearsarge, Houghton Co., Mich. An extensive producer, employing a large force. Organized 1890, under laws of Michigan, with capitalization $1,500,000, in 60,000 shares, par $25. Fiscal year ends June 30; annual meeting, first Monday in August. American Loan & Trust Co., Boston, transfer agent. John Stanton, president; John R. Stanton, secretary and treasurer; John Stanton, Jos. E. Gay, John R. Stanton, J. Wheeler Hardley and Samuel L. Smith, directors; Fred Smith, superintendent; Willard J. Smith, assistant superintendent; Chas. L. Noetzel, clerk; William Pollard, mining captain; B. S. Shearer, mill superintendent; F. Wm. Hartmann, mining engineer; A. B. Holtenhoff, master mechanic.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $780,000.00 |
| Amount paid in by conveyance of property to company | 550,000.00 |
| Entire amount invested in real estate | 720,665.23 |
| Amount of personal estate | 485,888.49 |
| Amount of unsecured or floating debt | 75,878.60 |
| Production of copper, 1901, in pounds | 4,946,126 |

For the fiscal year ending June 30, 1902, income was $665,333.28 and expenses $424,329.76, leaving a mining profit of $241,003.52. Expenditures for construction account were $264,677.90, leaving a surplus of $276,467.50. Dividends are $2 semi-annually, or at the rate of $240,000 per year. For the fiscal year named the mine hoisted 213,650 tons and stamped 187,482 tons, the rock stamped being 83% of the rock hoisted. Production was 6,232,800 pounds of mineral and 4,984,367 lbs. of refined copper, giving 71% of fine copper from the mineral. The yield of fine copper per ton of rock stamped was 26.59 lbs., or 1.33%. Cost of stamping was $1.94 per ton. Cost of refined copper was 7.304 cents per pound at the mine, with miscellaneous costs of 1.208 cents, giving a net cost for the year of 8.512 cents per pound, or, including all construction charges, a gross cost of 13.82 cents per pound. Dividends paid to close of 1902 were $990,000.

The Wolverine was opened in 1882 by local capital, but was not a success. The company was reorganized under the present title and management in 1890, when new machinery was secured and work resumed. Cash for necessary development was secured with difficulty and the previous failure of the mine rendered investors dubious of its future. The shortage of funds was met by Mr. John Stanton with cash advanced from his own pocket. Milling was begun in 1892, with a single stamp, after eighteen months of underground opening. With carefully selected rock the mine began making small profits from the first day of milling. The output of refined copper was only 500,074 pounds in 1892, but production has been greatly increased in each successive year, and should reach about 9,000,000 pounds in 1903.

Mineral lands comprise 280 acres, all on the copper belt, with upwards of 200 acres carrying the Kearsarge amgydaloid, on which the mine is opened. The North Kearsarge mine of the Osceola company lies on the north; Mayflower on the east; Mayflower and South Kearsarge on the south and Centennial on the west. The lode runs 15′ to 18′ wide, with an average dip of 41°, and is bunchy, but carries excellent average values.

The four shafts of the Wolverine are numbered from north to south. No. 1, near the North Kearsarge line, was exhausted long ago. Shafts 3 and 4 are the important producers. No. 3 is to the 23d level, about 2,200′, and No. 4 to the 19th level, about 1,800′. Both shafts are sinking in good ground. Some crosscutting has been done on the 11th level north and a few drifts opened on the "west lode," an amygdaloid paralleling the Kearsarge and showing nothing of special promise. The south drifts from No. 4 on the 12th to 18th levels, inclusive, are all very rich and but a small proportion of rock broken is rejected. Many new stopes have been opened in the past three years, preparatory to doubling production with the new mill, and the mine is now open for 5 to 6 years ahead of stoping, while new openings are being made at the rate of about 600′ monthly.

The surface equipment of the mine is not elaborate but is well adapted to present and future requirements. A compressor house, built at No. 4 in 1902, has a new compressor of 20-drill capacity, also the old 22-drill machine. A new changing house, built for miners at No. 3 shaft, is a model in every particular, and is much appreciated by the workmen. New oil and powder houses were built in 1902. The various shafts are substantial and well supplied with necessary machinery and buildings. The mining location is a very neat one and the company owns a large number of substantial dwellings, rented to employes at much lower figures than they could lease from private holders.

The old mill at the mine was sold to the Phoenix in 1902. Rock for the new mill goes over the Mohawk & Traverse Bay R. R., which is operated by the Mineral Range Railroad Co., under a five-year contract, the haul being 13 miles between mine and mill, with a continuous down grade for loaded trains.

The new mill is near the mouth of the Tobacco river, on Traverse Bay, Lake Superior, and adjoins the Mohawk mill, the two being served by a single pump and managed by a joint superintendent, thus allowing considerable operating economies. The mill is of steel, on stone foundations, 180x206′, standing 37′ above lake level, thus giving a good drop for tailings, with ample room to waste the sands. The mill has two Nordberg heads, striking about

110 blows per minute. Each head is treating a little better than 500 tons daily. The first head was started August 9, and the second head Aug. 27, 1902. The mill has a full complement of jigs and makes extensive use of Wilfley tables. The boiler house stands 16′ south of the mill and is 42x58′, with stone walls and steel truss roof, housing a battery of 200-h. p. Stirling water-tube boilers, fitted with automatic stokers. Coal goes through a lump-crusher, thence to hoppers in the boiler house with 24 hours' storage capacity. The mill also has a completely appointed machine shop.

The pump, owned and operated jointly by the Wolverine and Mohawk, is a horizontal triple-expansion Snow, of 20,000,000 gallons daily capacity, having steam cylinders of 18″, 33″ and 54″ diameter and 22″ water plungers with 36″ stroke. The pump house is located on the river, near its mouth, thus avoiding the difficulties encountered elsewhere in securing water from the lake. The coal and merchandise wharf, owned jointly by the mines, is near the mill and fitted with coal hoists. A 40-acre townsite has been platted near the mills and has been named Gay, in deserved honor of Jos. E. Gay, whose long and honorable connection with Lake Superior copper mining is well known to those interested in the trade.

Control of the Wolverine is owned in Michigan, this being the only Lake Superior copper mine in which the majority of stock is held outside of New England. This fact is evidence of the estimation in which the Wolverine is held by the people that have the best opportunities of judging of its value.

At the close of 1902 the Wolverine was making copper for less than 7 cents per pound and was producing at the rate of about 9,000,000 pounds yearly, thus making the cheapest copper in the Lake district, with the possible exception of the Calumet & Hecla. The Wolverine is the only Lake Superior mine that has maintained regular dividend rates during the depression of 1902, and its record is a remarkable one, for with the opening of its new mill the mine has nearly doubled production; has greatly reduced costs; has increased the percentage of copper in rock milled, and has greatly increased its net earnings, simultaneously. It would be hard to find a copper mine or a mine management to which more unqualified commendation can be given.

**WOLVERINE MINING CO.** **UTAH.**

Office: 324 D. F. Walker Bldg., Salt Lake City, Utah. Mine office: Park City, Summit Co., Utah. Employs 25 men. Martin L. Effinger, vice-president; L. A. Jeffs, superintendent. Has a main tunnel of 450′ and about 1,000′ of underground openings. Has had assays of 39% lead and 56 oz. silver per ton, in addition to copper. No returns secured.

**WOOD RIVER GOLD & COPPER CO.**

Incorporated October, 1902, under laws of Delaware, with capitalization $1,000,000, by W. W. Watson, et al, of Scranton, Pa. No returns secured.

**WYACCA MINE.** **AUSTRALIA.**

Address: care of E. Pearce, Broken Hill Chambers, Adelaide, South Australia. Property was working on a very limited scale at last accounts.

**WYANDOT COPPER CO.** **MICHIGAN.**

Office: 24 Congress St., Boston, Mass. Mine office: Winona, Houghton

Co., Mich. Organized 1899, under laws of Michigan, with capitalization $2,500,000, shares $25 par, $8 paid in. Old Colony Trust Co., Boston, registrar. Annual meeting, first day of May. Henry Stackpole, president; Wm. O. Gay, secretary and treasurer; Henry Stackpole, Wm. O. Gay, Joseph Dorr, Irving J. Sturgis and Matthew Van Orden, directors; Frank L. Van Orden, superintendent; Thos. Buzzo, mining captain.

Official sworn returns to the state of Michigan, as of date Jan. 1, 1902, disclose the following figures:

| | |
|---|---|
| Amount cash paid in on capital stock | $800,000.00 |
| Entire amount invested in real estate | 500,000.00 |
| Amount of personal estate (cash and cash accounts) | 75,000.00 |

Property is 1,040 acres of virgin ground, 25 miles southwest of Houghton, adjoining the Winona mine, in Sections 16, 20 and 21, Town 52 North, Range 36 West, in Houghton Co. Tract is crossed by Copper Range railroad. Surface improvements include machine and blacksmith shops, warehouse, office, barns, and about 12 new dwellings, with boilers, hoists, shop machinery and tools.

Exploratory work was begun February, 1899, and has been continued uninterruptedly. The overburden is very heavy, greatly impeding both shaft-sinking and diamond drilling. Early work was performed in search of the Winona lode, while latter efforts have been made with a view to locating the southern extension of the Baltic amygdaloid. No. 1 shaft, 261′ deep, is on an amygdaloid supposed to be the Winona, having a parallel underlying amygdaloid bed 60′ distant, both being broken and of poor promise, though showing occasional patches of well-mineralized ground. Shaft No. 11, 100′ deep, is about a quarter-mile from No. 1, showing the same disturbed and unsatisfactory formation, with parallel amygdaloids 50′ apart, these giving occasional bunches of good ground, but not payable at the depth gained. A shaft has been sunk 102′ on a lean cupiferous conglomerate underlying the Winona bed. A 300′ shaft on an amygdaloid identified as the Elm River gave an unsatisfactory showing.

All shafts having given such poor showings, mining work was stopped August, 1901, and boring continued with two diamond drills. These began work at the Eastern sandstone and worked backwards to the west, securing a nearly complete geological cross-section of the Wyandot tract, under great difficulties, owing to the heavy overburden of sand and boulders, this running 100′ to 300′ deep and averaging nearly 200′ for the various holes. The drill-cores show that the formation is much disturbed across the entire tract. Drilling was stopped in the fall of 1902, and a new vertical shaft started on section 28, about 1,200′ west of the Eastern sandstone. This penetrates a 95′ overburden and is bottomed in a conglomerate, thought to be No. 3, which underlies the Baltic amygdaloid some 15 miles to the northeast. This shaft is about 25′ in the ledge at the close of 1902, and when the formation is more settled, at a depth of 75′ to 100′ in the rock, crosscuts will be sent both east and west, in search of the Baltic lode.

**WYOMING CONSOLIDATED COPPER CO. WYOMING.**

Mine office: Collins, Carbon Co., Wyo. B. Shaw, president, Boston, Mass. Lands, 17 claims, including the Cox mine. Was doing a little development work at the close of 1902.

**WYOMING COPPER & GOLD MINING CO. WYOMING.**

Office: Alma, Kansas. C. B. Henderson, manager. Property supposed to be in Carbon Co., Wyoming, but no returns secured.

**WYOMING MINING & MILLING CO. WYOMING.**

Mine office: Kirwin, Big Horn Co., Wyo. C. L. Tewksbury, superintendent. Has a 100′ shaft. No returns secured.

**WYOMING QUEEN MINING CO. WYOMING.**

Office: Laramie, Wyo. Mine office: Jelm, Albany Co., Wyo. Employs 12 men. Organized 1902, under laws of Wyoming, with capitalization $1,000,000, shares $1 par. Louis Miller, president and general manager; L. A. Hancock, vice-president; J. H. Brazier, secretary; J. F. Johnson, treasurer; preceding officers, J. M. Fenwick, John Benzin, E. F. Fairbrother and Ole Scar, directors. Lands, 18 claims, area 355 acres, also 20 acres miscellaneous lands, in the Jelm Mountain district of Albany Co., showing various fissure veins carrying oxidized copper ores and galena. Has shafts of 38′, 100′ and 110′. Will continue sinking and drifting and install power hoists and drills in 1903.

**WYOMING & ALABAMA MINING CO. WYOMING.**

Mine office: Tie Siding, Wyo. P. E. Kinnaman, superintendent. Employed a small force on development work at last accounts.

**WYONA IRON & COPPER CO. WYOMING.**

Office: 928 Equitable Bldg., Denver, Colo. Owns 100 acres of copper lands near Battle, Carbon Co., Wyo. No returns secured for 1902.

**COMPANIA MINERA YABRICOYA. CHILE.**

Works the Aguada copper-silver mine near Iquique, Tarapaca, Chile.

**YAEGER CANON COPPER CO. ARIZONA.**

Office: probably Detroit, Mich. Mine office: Prescott, Yavapai Co., Ariz. Jos. B. Tomlinson, superintendent. Ores carry copper, gold and silver. Mine opened by 550′ shaft and 270′ tunnel. Has steam power and was figuring on installing a 200-ton concentrator at last accounts. No returns secured.

**YAQUI COPPER CO. MEXICO.**

Office: 170 Broadway, New York. Mexican general office: Hermosillo, Sonora, Mexico. Mine office: Suaqui de Batuc, Sonora, Mex. Capitalization $5,000,000, in 500,000 shares, par $10, with 125,000 shares unissued. Col. W. P. Harlow, president and general manager; Wm. Sauntry, vice-president; Senator Geo. E. Green, secretary and treasurer; Col. W. P. Harlow, Chas. D. Cooke, Col. John H. Martin, Senator John M. Thurston, Geo. W. Fairchild, Wm. Sauntry, C. F. Wright, Geo. E. Green, Dr. A. E. Magoris, N. L. Miller and T. S. Coolidge, directors; Chas. A. Kaiser, assistant manager; W. E. Pomeroy, superintendent; Gen. Henry Ide Willey, mining engineer.

Col. W. C. Greene, of the Greene Consolidated, is said to be heavily interested in this property.

Lands are 6,032 acres of mineral ground, also 119,284 acres of timber and grazing lands, and water rights to 25 miles of the Yaqui river, mining lands being in the neighborhood of Suaqui de Batuc, Campo Santo Nino, Sonora, Mexico, in the Sierra Madre Mountains, about 120 miles from Hermosillo. The property shows antiguas, or old mines, which are supposed to have been worked by the Aztecs, as there are no records of their operation under Spanish dominion. The tract is well watered and well timbered, except in the more mountainous portions. In addition to the mines of gold, silver and copper, the tract carries iron ore, apparently of good grade and in large quantity, although no attempts have been made to explore the property for iron, and it is not likely that such attempts will be made until there are greater opportunities in Mexico and the southwestern states of America for the manufacture of iron. The tract also carries coal beds that are of decided promise and will be carefully investigated later with a view to furnishing fuel for the smelting operations of the company.

The copper ore body of the Yaqui company is of simply staggering size. The main dyke has a strike of approximately northeast and southwest and is crossed by another and somewhat smaller vein at nearly right angles. The ore body is variously estimated as 2½ to 8 miles in length and from 80′ to 800′ in width, and is of unknown depth, although there is one exposure of a quarter-mile in depth on the face of a mountain. The vein is carried between granite and limestone walls, showing oxidized ores in the upper part with solid sulphides below, all carrying large percentages of gold and fair percentages of copper. Ores noted in this body are cuprite, melaconite, malachite, azurite, chalcocite, bornite and chalcopyrite. Assays from selected samples have given 22% to 54% copper, and the average of a large number of assays of supposedly average samples is 14.92% copper, 2.09 oz. gold and 6.6 oz. silver per ton.

Work was begun in the spring of 1901, and at the close of 1902 about 150 miners were employed. Company is now sinking 2 shafts and driving 8 tunnels. The ore stands well and requires little timbering. A club-house has been built for the American superintendents and employes. The company also has a good office building and a store carrying a large stock, employes taking their pay largely in goods. There are two villages adjoining the mine, one inhabited by the Mexican workmen and the other by Yaqui Indians. The Yaquis are admitted by all American mine operators to be the best mine workmen in Mexico, as they are intelligent, strong and both willing and able to do a good day's work, provided always that they are given fair wages and decent treatment.

The company plans erecting a mammoth smelter upon a site on the Yaqui river, 3 miles from the mine and 4,000′ lower, to which ores will be sent by gravity or aerial tram. It is planned to make this smelter of 5,000 tons capacity, although it is probable that production will begin with a 500-ton or 1,000-ton section. A disadvantage of the property is the distance from railroad connections, this being about 75 miles, but a property of this promise should not lack rail communication for long, even in so rugged a country as the Sierra Madre range of Mexico. In smelting operations the company will have several exceptional advantages, as the property has fluxes at the mine in the shape of low-grade copper ores and the limestone contact wall. There is a good water supply, unlimited water power on the adjoining river awaiting development, and wood and coal for fuel on the company's lands.

This company has some very strong people in its directorate, with able and experienced men at the head of its management. The owners are firmly of the belief that they have the biggest copper mine in the world, and that they have one of the largest, in embryo, is scarcely open to doubt.

**YAVAPAI COPPER CO. ARIZONA.**

Office: 317 Main St., Springfield, Mass. Mineral lands, supposedly in Verde district of Yavapai Co., Ariz. W. H. Riderman in charge at last accounts. Company gives no replies to repeated requests for information.

**YELTA MINE. AUSTRALIA.**

A South Australian copper property, 420′ deep; idle at last accounts.

**YENESEI COPPER CO., LTD. SIBERIA.**

Offices: 70, Queen Victoria St., London, E. C., Eng. Capital, nominal, £300,000, in £1 shares. Organized to acquire certain copper mining concessions in the districts of Minusinsk and Achinsk, Province of Yenesei, Siberia, presumably from A. G. Terschoff. No returns secured.

**YORK HARBOUR COPPER CO., LTD. NEWFOUNDLAND.**

Offices: 13, Spring Garden, Manchester, Eng. T. S. Turnbull, chairman; J. Hall, secretary; Jas. Hooper, mine superintendent. Capital, nominal, £12,000. Mine is at York Harbour, Bay of Islands, Newfoundland.

**YOSEMITE & SAMPSON GROUP. UTAH.**

Property is in the Bingham camp. Supposed to be under option at $70,000 to the Bingham Consolidated.

**YOSHIOKA MINE. JAPAN.**

In the Province of Bichu, Japan. Opened in the Ninth century and has been worked almost continuously for a thousand years, notwithstanding which ore bodies of large extent remain unmined. Mining and smelting plant is mainly modern. Production was 648 tons of fine copper in 1894.

**YREKA COPPER CO. BRITISH COLUMBIA.**

Office: 515 Fidelity Bldg., Tacoma, Wash. Mine office: Yreka, Vancouver Island, B. C. Employs 100 men. Organized 1901, under laws of Washington, with capitalization $2,000,000, shares $1 par. H. S. Owen, president; C. D. Lynn, vice-president; S. T. Lewis, secretary and general manager; N. S. Clarke, general superintendent; W. C. Spicer, treasurer. Lands, 19 claims, 16 patented claims being on Comstock Mountain, Quatsino Sound, Vancouver Island, B. C., with 3 unpatented claims in the Victoria district, 2 miles from tidewater, on the eastern side of the island. This group, known as the Yreka, is not worked at present, operations being confined to the Comstock and Superior groups on Quatsino Sound. Ores are sulphide, with estimated average value of 7% copper, $2 gold and 2 oz. silver per ton. Mine is opened as a quarry, 60′ across the ledge, with no walls on either side as yet. Tunnel is driving to strike this ore body at a depth of 235′. It is thought the vein may prove as wide as 250′ to 300′. The length is about 3,000′, with enormous outcrops of solid sulphide ore. Amount of ore in sight is variously estimated at 2.000,000 to 4,000,000 tons, with about 500,000 tons available for stoping, in the quarry. An aerial tram with capacity of 600 tons is nearing completion and shipments to custom smelter will begin early in 1903. This property is one of unusual promise.

**YTTEROEN MINE.** **NORWAY.**

This Norwegian mine produced 1,300 tons of cupriferous pyrites in 1900. No returns secured.

**YUDA COPPER CO., LTD.** **AUSTRALIA.**

Offices: 13, St. Helen's Pl., London, E. C., Eng. Capital, nominal, £120,000. Organized to acquire mining properties in South Australia, regarding which no particulars are given.

**COMPANHIA DE ZAMBEZIA.** **PORTUGUESE EAST AFRICA.**

Offices: 53, Rua do Alecrim, Lisbon, Portugal, and Rue Lafayette, 10, Paris, France. Capital, nominal, 2,700 contos do reis. Property is a concession of 60,000 square miles on either side of the Zambesi and Shire rivers, extending east of latter to the coast, and embracing the ports of Quelimane and Chinde, Portuguese East Africa. Concession includes copper-bearing fields of prospective value.

**ZARAGOZA COPPER & ZINC MINES, LTD.** **SPAIN.**

Offices: 19-20, Queen Victoria St., London, E. C., Eng. A. Maconochie, chairman; A. H. Greenhill, secretary. Capital, nominal, £60,000; issued, £7. Organized to acquire mines in Spain under agreement with the Rio Tenido Copper Mines, Ltd.

# CHAPTER XVI.

## GENERAL COPPER STATISTICS.

In this chapter will be found practically every table given in the preceding issues of the work, in addition to about a dozen entirely new tables, yet the statistics occupy fewer pages than in either of the preceding editions. This result has been secured by consolidating two and in some cases three tables into one, so that in place of the skeleton tables of the first edition, with one or two columns only, the present chapter gives statistical compilations with all available space occupied by solid columns of figures. This arrangement will be found saving of time to those that consult the tables of this chapter, as well as economical of space.

While all of the tables are fully indexed and cross-referenced in the index next following, the following condensed table of contents, which also sets forth the arrangement and order of the tables, will facilitate reference to the various features of the copper industry covered by the statistics of this chapter:

WORLD'S COPPER PRODUCTION: By Countries, from 1890 to 1901, For Nineteenth Century, By Largest Mines, By Various Mines, Estimate for 1902—pages 564 to 570.

AMERICAN COPPER PRODUCTION: From 1850 to 1901, By States—pages 571–572.

LAKE SUPERIOR COPPER PRODUCTION: By Mines, Production and Value 1845 to 1902—pages 572 to 574.

AMERICAN EXPORTS: Exports 1865 to 1901, By Ports, By Destinations—pages 574 to 575.

AMERICAN IMPORTS:—page 576.

COPPER TRADE OF THE WORLD: Detailed Tables by Countries—pages 576 to 581.

PRICES AND VALUES: Sundry Tables—pages 582 to 586.

DIVIDENDS, ASSESSMENTS AND GENERAL FINANCES: Prices and Sales of Listed American Shares, Dividends of American Mines, Dividends of Lake Superior Mines, Dividends and Assessments of Lake Mines, Capitalization of Lake Copper Companies—pages 586 to 593.

SUNDRY LOCAL STATISTICS: Forces Employed by Michigan and Montana Mines, Number of Shareholders in Lake Copper Companies—page 594.

FUTURE PRODUCTION OF COPPER: Sundry Tables based upon Production of the Nineteenth century—pages 595 to 596.

## WORLD'S COPPER PRODUCTION BY COUNTRIES.

1890–1901.

(*Long Tons.*)

| Country. | 1890. | 1896. | 1897. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|---|---|---|
| Algeria | 120 | ...... | ...... | ...... | ...... | ...... | ...... |
| Argentina | 150 | 100 | 200 | 125 | 65 | 775 | 780 |
| Australasia | 7,500 | 11,000 | 17,000 | 18,000 | 20,750 | 23,000 | 30,875 |
| Austria | 1,210 | 1,075 | 1,210 | 1,110 | 915 | 865 | 1,015 |
| Bolivia | 1,900 | 2,000 | 2,200 | 2,050 | 2,500 | 2,100 | 2,000 |
| Canada | 3,050 | 4,000 | 5,905 | 8,040 | 6,730 | 8,500 | 18,800 |
| Chile | 26,120 | 23,500 | 21,900 | 24,850 | 25,000 | 25,700 | 30,000 |
| Cape Colony | 6,450 | 7,450 | 7,440 | 7,060 | 6,490 | 6,720 | 6,400 |
| Great Britain | 935 | 555 | 520 | 640 | 650 | 650 | 600 |
| Germany | 17,625 | 20,065 | 20,145 | 20,085 | 23,460 | 20,410 | 21,720 |
| Hungary | 300 | 210 | 445 | 430 | 590 | 490 | 320 |
| Italy | 2,200 | 3,400 | 3,480 | 2,965 | 2,965 | 2,955 | 3,000 |
| Japan | 15,000 | 21,000 | 23,000 | 25,175 | 28,310 | 27,840 | 27,475 |
| Mexico | 4,325 | 11,150 | 13,370 | 16,435 | 19,335 | 22,050 | 23,795 |
| Newfoundland | 1,735 | 1,800 | 1,800 | 2,100 | 2,700 | 1,900 | 2,000 |
| Norway | 1,390 | 2,500 | 3,450 | 3,615 | 3,610 | 3,935 | 3,375 |
| Peru | 150 | 740 | 1,000 | 3,040 | 5,165 | 8,220 | 9,520 |
| Russia | 4,800 | 5,100 | 6,025 | 6,260 | 7,210 | 8,000 | 8,000 |
| Sweden | 830 | 500 | 545 | 480 | 520 | 450 | 450 |
| Spain & Portugal | 51,700 | 53,325 | 53,060 | 52,375 | 52,168 | 52,872 | 53,621 |
| United States | 115,966 | 205,384 | 220,571 | 235,050 | 253,870 | 269,111 | 268,522 |
| Turkey | ...... | ...... | 975 | 470 | 920 | 520 | 980 |
| Venezuela | 5,640 | ...... | ...... | ...... | ...... | ...... | ...... |
| Totals | 269,096 | 374,854 | 404,241 | 430,405 | 463,908 | 486,363 | 513,243 |

## WORLD'S COPPER PRODUCTION.

1880–1901.

(*Long Tons.*)

| Year. | United States. | Foreign. | Total. | Percentage of U. S. Production. |
|---|---|---|---|---|
| 1880 | 27,000 | 126,959 | 153,959 | 17 |
| 1881 | 32,000 | 131,000 | 163,000 | 19 |
| 1882 | 40,467 | 141,155 | 181,622 | 22 |
| 1883 | 51,574 | 147,832 | 199,406 | 24 |
| 1884 | 64,708 | 155,141 | 220,249 | 29 |
| 1885 | 74,052 | 151,540 | 225,592 | 32 |
| 1886 | 70,430 | 146,656 | 217,086 | 32 |
| 1887 | 81,017 | 142,781 | 223,798 | 36 |
| 1888 | 101,054 | 156,972 | 258,026 | 39 |
| 1889 | 101,239 | 159,966 | 261,205 | 38 |
| 1890 | 115,966 | 153,489 | 269,455 | 43 |
| 1891 | 126,839 | 152,552 | 279,391 | 45 |
| 1892 | 154,018 | 156,454 | 310,472 | 49 |
| 1893 | 147,033 | 156,497 | 303,530 | 48 |
| 1894 | 158,120 | 166,385 | 324,505 | 49 |
| 1895 | 169,917 | 164,648 | 334,565 | 50 |
| 1896 | 205,384 | 167,979 | 373,363 | 54 |
| 1897 | 220,571 | 178,384 | 398,955 | 54 |
| 1898 | 235,050 | 194,106 | 429,156 | 54 |
| 1899 | 253,870 | 215,440 | 469,310 | 54 |
| 1900 | 269,111 | 216,743 | 485,854 | 57 |
| 1901 | 268,522 | 242,497 | 511,019 | 53 |

## WORLD'S PRODUCTION FOR THE NINETEENTH CENTURY.

(*Long Tons.*)

| DECADE. | Average Price of Rough Copper. | World's Production of Each Decade. | Increase of Production over Previous Decades. | Average Annual Production for Each Decade. | Increase of Average Annual Production. |
|---|---|---|---|---|---|
| 1801 to 1810 | £160 | 91,000 | ........ | 9,100 | ...... |
| 1811 to 1820 | 130 | 96,000 | 5,000 | 9,600 | 500 |
| 1821 to 1830 | 101 | 135,000 | 39,000 | 13,500 | 3,900 |
| 1831 to 1840 | 94 | 218,400 | 83,400 | 21,840 | 8,340 |
| 1841 to 1850 | 83 | 291,000 | 72,600 | 29,100 | 7,260 |
| 1851 to 1860 | 111 | 506,999 | 215,999 | 50,699 | 21,599 |
| 1861 to 1870 | 87 | 900,000 | 393,001 | 90,000 | 39,300 |
| 1871 to 1880 | 79 | 1,189,000 | 289,000 | 118,900 | 28,900 |
| 1881 to 1890 | 60 | 2,373,398 | 1,084,398 | 237,339 | 108,439 |
| 1891 to 1900 | 52 | 3,708,901 | 1,335,503 | 370,890 | 133,550 |
| Totals and Averages | 96 | 9,507,299 | ......... | 95,073 | ...... |

## PRODUCTION OF WORLD'S LARGEST MINES.

1867–1901.

(*Pounds.*)

| Year. | Calumet & Hecla. | Anaconda. | Rio Tinto. | Boston & Montana. | Mansfeld. | Copper Queen. |
|---|---|---|---|---|---|---|
| 1867.. | 1,315,173 | .......... | ......... | ......... | ......... | ......... |
| 1868.. | 5,098,375 | .......... | ......... | ......... | ......... | ......... |
| 1869.. | 12,315,771 | .......... | ......... | ......... | ......... | ......... |
| 1870.. | 14,031,584 | .......... | ......... | ......... | ......... | ......... |
| 1871.. | 16,222,590 | .......... | ......... | ......... | ......... | ......... |
| 1872.. | 16,162,183 | .......... | ......... | ......... | ......... | ......... |
| 1873.. | 18,848,265 | .......... | ......... | ......... | ......... | ......... |
| 1874.. | 20,125,225 | .......... | ......... | ......... | ......... | ......... |
| 1875.. | 21,473,954 | .......... | ......... | ......... | ......... | ......... |
| 1876.. | 21,690,732 | .......... | 11,731,708 | ......... | ......... | ......... |
| 1877.. | 23,568,468 | .......... | 41,057,139 | ......... | ......... | ......... |
| 1878.. | 25,253,128 | .......... | 54,245,564 | ......... | ......... | ......... |
| 1879.. | 26,270,943 | .......... | 50,228,595 | ......... | ......... | ......... |
| 1880.. | 31,675,239 | .......... | 58,775,915 | ......... | ......... | ......... |
| 1881.. | 31,360,781 | .......... | 61,171,913 | ......... | ......... | ......... |
| 1882.. | 32,053,528 | .......... | 38,951,360 | ......... | 25,795,840 | ......... |
| 1883.. | 33,125,045 | .......... | 45,857,280 | ......... | 28,310,320 | ......... |
| 1884.. | 40,473,585 | .......... | 48,303,360 | ......... | 28,183,680 | ......... |
| 1885.. | 47,247,990 | .......... | 52,604,160 | ......... | 27,888,000 | ......... |
| 1886.. | 50,518,220 | .......... | 55,328,000 | ......... | 28,212,800 | ......... |
| 1887.. | 46,016,123 | .......... | 63,840,000 | ......... | 29,176,000 | ......... |
| 1888.. | 50,295,721 | .......... | 63,840,000 | ......... | 29,970,200 | ......... |
| 1889.. | 48,668,296 | .......... | 66,080,000 | ......... | 34,733,440 | ......... |
| 1890.. | 59,868,106 | .......... | 67,200,000 | ......... | 35,392,000 | ......... |
| 1891.. | 63,586,620 | .......... | 71,680,000 | ......... | 30,920,000 | ......... |
| 1892.. | 56,495,211 | .......... | 70,560,000 | ......... | 34,406,400 | ......... |
| 1893.. | 60,427,913 | .......... | 69,664,000 | ......... | 31,696,000 | ......... |

## PRODUCTION OF WORLD'S LARGEST MINES. (Continued.)

| Year. | Calumet & Hecla. | Anaconda. | Rio Tinto. | Boston & Montana. | Mansfeld. | Copper Queen. |
|---|---|---|---|---|---|---|
| 1894.. | 61,324,626 | 95,578,000 | 73,920,000 | 50,000,000 | 33,677,600 | ......... |
| 1895.. | 79,137,399 | 99,775,294 | 75,040,000 | 55,000,000 | 33,286,400 | 15,741,731 |
| 1896.. | 89,280,621 | 125,350,693 | 73,920,000 | 60,250,000 | 40,913,600 | 23,298,150 |
| 1897.. | 83,248,054 | 131,471,127 | 75,936,000 | 60,000,000 | 40,230,400 | 23,999,873 |
| 1898.. | 86,426,320 | 107,214,059 | 75,499,200 | 62,000,000 | 40,420,800 | 33,749,390 |
| 1899.. | 89,610,963 | 107,914,357 | 76,988,800 | 65,000,000 | 46,558,400 | 36,901,684 |
| 1900.. | 77,761,382 | 110,000,000 | 80,039,680 | 66,200,000 | 41,193,600 | 34,382,309 |
| 1901.. | 82,519,676 | 101,850,224 | 79,179,520 | 50,000,000 | 41,067,200 | 39,781,333 |

## PRODUCTION OF VARIOUS MINES.

The following table gives exact production, or estimates based on the best data available, of the world's leading copper mines, and a number of the smaller producers as well, for the latest year regarding which satisfactory returns have been secured:

(*Pounds.*)

| No. | Mine or Company. | Location. | Year. | Product. |
|---|---|---|---|---|
| 1 | Anaconda.................. | Montana, U. S. A.. | 1901 | 101,850,224 |
| 2 | Calumet & Hecla............ | Michigan, U. S. A.. | 1902 | 81,248,739 |
| 3 | Rio Tinto.................. | Spain........... | 1901 | 79,179,520 |
| 4 | Boston & Montana .......... | Montana, U. S. A. | 1901 | 50,000,000 |
| 5 | Mansfeld................... | Germany......... | 1901 | 42,068,177 |
| 6 | Copper Queen............... | Arizona, U. S. A.. | 1901 | 39,781,333 |
| 7 | United Verde ............... | Arizona, U. S. A... | 1901 | 34,520,695 |
| 9 | Montana O. P. Co........... | Montana, U. S. A. | 1901 | 29,898,980 |
| 8 | Mountain .................. | California, U. S. A . | 1901 | 29,727,040 |
| 10 | Boleo...................... | Mexico .......... | 1901 | 24,153,957 |
| 11 | Arizona Copper Co .......... | Arizona, U. S. A... | 1901 | 20,535,800 |
| 12 | Quincy ..................... | Michigan, U. S. A.. | 1902 | 18,988,491 |
| 13 | Tamarack................... | Michigan, U. S. A.. | 1901 | 18,000,852 |
| 14 | Butte Reduction Works...... | Montana, U. S. A. | 1901 | 17,969,663 |
| 15 | Detroit ..................... | Arizona, U. S. A... | 1901 | 17,535,000 |
| 16 | Furukawa Copper Co......... | Japan ........... | 1901 | 17,500,000 |
| 17 | Mt. Lyell .................. | Tasmania ........ | 1902 | 17,111,360 |
| 18 | Tharsis .................... | Spain............ | 1901 | 16,636,480 |
| 19 | Lota y Coronel............. | Chile ............ | 1901 | 15,000,000 |
| 20 | Wallaroo & Moonta.......... | Australia......... | 1902 | 14,000,000 |
| 21 | Greene Consolidated ......... | Mexico .......... | 1901 | 13,854,170 |
| 22 | Chilena de Fundiciones....... | Chile ............ | 1901 | 13,500,000 |
| 23 | Osceola.................... | Michigan, U. S. A.. | 1902 | 13,416 396 |
| 24 | Utah Consolidated........... | Utah, U. S. A.... | 1902 | 11,135,040 |
| 25 | Parrot...................... | Montana, U. S. A. | 1901 | 10,167,850 |
| 26 | Old Dominion............... | Arizona, U. S. A... | 1901 | 10,094,787 |
| 27 | Bingham.................... | Utah, U. S. A.... | 1902 | 10,000,000 |
| 28 | Besshi...................... | Japan ........... | 1901 | 9,000,000 |
| 29 | O'okiep..................... | South Africa ..... | 1902 | 8,750,000 |
| 30 | Moctezuma.................. | Mexico .......... | 1901 | 8,614,161 |
| 31 | Mason & Barry, Ltd......... | Portugal......... | 1901 | 8,353,229 |
| 32 | Butte & Boston.............. | Montana, U. S. A. | 1901 | 8,028,746 |
| 33 | Colorado.................... | Montana, U. S. A. | 1901 | 7,465,260 |
| 34 | Wolverine................... | Michigan, U. S. A.. | 1902 | 6,473,181 |
| 35 | Baltic ...................... | Michigan, U. S. A.. | 1902 | 6,285,819 |
| 36 | North Mt. Lyell............. | Tasmania ........ | 1902 | 6,000,000 |

## PRODUCTION OF VARIOUS MINES. (Continued.)

(*Pounds.*)

| No. | Mine or Company. | Location. | Year. | Product. |
|---|---|---|---|---|
| 37 | Great Cobar | Australia | 1898 | 5,644,800 |
| 38 | Namaqua | South Africa | 1901 | 5,376,000 |
| 39 | Franklin | Michigan, U. S. A. | 1902 | 5,259,140 |
| 40 | Atlantic | Michigan, U. S. A. | 1902 | 4,949,366 |
| 41 | Trimountain | Michigan, U. S. A. | 1902 | 6,000,000 |
| 42 | Sulitelma | Norway | 1902 | 4,500,000 |
| 43 | British Columbia | Canada | 1902 | 4,500,000 |
| 44 | Katarski | Russia | 1899 | 4,488,000 |
| 45 | Sociedad Ind. de Atacama | Chile | 1902 | 4,480,000 |
| 46 | Tilt Cove | Newfoundland | 1901 | 4,250,000 |
| 47 | Mt. Garnet | Australia | 1901 | 4,220,016 |
| 48 | Huanchaca de Bolivia | Chile | 1901 | 4,200,000 |
| 49 | Champion | Michigan, U. S. A. | 1902 | 4,165,784 |
| 50 | Dominion | Canada | 1902 | 4,000,000 |
| 51 | Copiapo | Chile | 1901 | 4,000,000 |
| 52 | Carrizal | Chile | 1901 | 4,000,000 |
| 53 | Tinto & Santa Rosa | Spain | 1901 | 3,673,600 |
| 54 | Granby Consolidated | Canada | 1901 | 3,500,000 |
| 55 | Arghana Maden | Turkey | 1900 | 3,309,600 |
| 56 | Kedabenski | Russia | 1899 | 3,300,000 |
| 57 | Fundicion Templeman | Chile | 1901 | 3,250,000 |
| 58 | Santiago Vicuna | Chile | 1901 | 3,250,000 |
| 59 | Central Chile Copper Co | Chile | 1901 | 3,136,000 |
| 60 | Montecatini | Italy | 1902 | 3,134,526 |
| 61 | Ani group | Japan | 1899 | 3,000,000 |
| 62 | Canadian Copper Co | Canada | 1902 | 3,000,000 |
| 63 | Ducktown | Tennessee, U.S.A. | 1901 | 3,000,000 |
| 64 | Le Roi | Canada | 1901 | 3,000,000 |
| 65 | Washoe | Montana, U. S. A. | 1902 | 3,000,000 |
| 66 | Colusa-Parrot | Montana, U. S. A. | 1902 | 3,000,000 |
| 67 | Artola Hermanos | Chile | 1901 | 3,000,000 |
| 68 | Besa y Ca | Chile | 1901 | 2,912,000 |
| 69 | Rudianski | Russia | 1899 | 2,910,082 |
| 70 | Sevilla | Spain | 1901 | 2,894,639 |
| 71 | Coro Coro | Bolivia | 1901 | 2,856,000 |
| 72 | Mass | Michigan, U. S. A. | 1902 | 2,700,000 |
| 73 | Rammelsberg | Germany | 1902 | 2,500,000 |
| 74 | Bogoslovski | Russia | 1899 | 2,480,674 |
| 75 | Mitsu Bishi | Japan | 1902 | 2,448,000 |
| 76 | Noel Berthini | Bolivia | 1901 | 2,419,200 |
| 77 | "Lloyd" | Australia | 1901 | 2,372,160 |
| 78 | Daly-West | Utah, U. S. A. | 1901 | 2,310,617 |
| 79 | Osarusawa | Japan | 1900 | 2,250,000 |
| 80 | Copper Corp'n of Chile | Chile | 1901 | 2,200,000 |
| 81 | Isle Royale | Michigan, U. S. A. | 1901 | 2,171,955 |
| 82 | Meraker | Norway | 1895 | 2,150,400 |
| 83 | Sado | Japan | 1901 | 2,150,000 |
| 84 | Shannon | Arizona, U. S. A. | 1902 | 2,068,000 |
| 85 | Felix Vicuna | Chile | 1901 | 2,000,000 |
| 86 | Lake George | Australia | 1901 | 2,000,000 |
| 87 | North American Copper Co. | Wyoming, U. S. A. | 1902 | 2,000,000 |
| 88 | Mt. Shasta | California | 1902 | 2,000,000 |
| 89 | Intercolonial | Canada | 1902 | 2,000,000 |
| 90 | Copper King, Ltd | California, U. S. A. | 1902 | 2,000,000 |

### PRODUCTION OF VARIOUS MINES. (Continued.)

(*Pounds.*)

| No. | Mine or Company. | Location. | Year. | Product. |
|---|---|---|---|---|
| 91 | Copperfield | Vermont, U. S. A. | 1902 | 2,000,000 |
| 92 | Arakawa | Japan | 1899 | 2,000,000 |
| 93 | Montreal & Boston | Canada | 1902 | 1,800,000 |
| 94 | Sotiel Coronada | Spain | 1899 | 1,780,800 |
| 95 | San Miguel | Spain | 1899 | 1,767,360 |
| 96 | Sucesion Cervero | Chile | 1901 | 1,750,000 |
| 97 | Catemou | Chile | 1901 | 1,625,000 |
| 98 | Sucesion P. Gonzales | Chile | 1901 | 1,568,000 |
| 99 | El Orito | Chile | 1901 | 1,560,000 |
| 100 | Castillo de Buitron | Spain | 1901 | 1,500,000 |
| 101 | Kusakura | Japan | 1901 | 1,500,000 |
| 102 | Nymagee | Australia | 1901 | 1,500,000 |
| 103 | Penn | California, U. S. A. | 1901 | 1,500,000 |
| 104 | Yoshioka | Japan | 1894 | 1,451,520 |
| 105 | Santa Inez y Morrococha | Peru | 1902 | 1,450,000 |
| 106 | Sucesion C. J. Lambert | Chile | 1901 | 1,350,000 |
| 107 | J. K. Child & Co. | Bolivia | 1901 | 1,350,000 |
| 108 | Sucesion Ramon F. Ovalle | Chile | 1901 | 1,350,000 |
| 109 | Ogoya | Japan | 1900 | 1,344,000 |
| 110 | Galizurski | Russia | 1899 | 1,308,796 |
| 111 | Röros | Norway | 1898 | 1,303,680 |
| 112 | Las Herrerias | Spain | 1901 | 1,300,714 |
| 113 | Gulf Creek | Australia | 1901 | 1,254,400 |
| 114 | Calumet & Arizona | Arizona, U. S. A. | 1902 | 1,200,000 |
| 115 | Van Anda | Canada | 1900 | 1,127,533 |
| 116 | Helsingborg | Sweden | 1901 | 1,078,384 |
| 117 | Aljustrel | Portugal | 1901 | 1,000,000 |
| 118 | Burra Burra | Australia | 1901 | 1,000,000 |
| 119 | Blinman | Australia | 1901 | 1,000,000 |
| 120 | Capillitas | Argentina | 1901 | 1,000,000 |
| 121 | Cabezas del Pasto | Spain | 1901 | 1,000,000 |
| 122 | Great Central | Australia | 1901 | 1,000,000 |
| 123 | Graslitz | Austria | 1902 | 1,000,000 |
| 124 | Hall | Canada | 1901 | 1,000,000 |
| 125 | Komaki | Japan | 1900 | 1,000,000 |
| 126 | Kupferplatte | Austria | 1900 | 1,000,000 |
| 127 | Killingdal | Norway | 1901 | 1,000,000 |
| 128 | Lyell Tharsis | Tasmania | 1901 | 1,000,000 |
| 129 | Libiola | Italy | 1902 | 1,000,000 |
| 130 | Llallai | Chile | 1901 | 1,000,000 |
| 131 | Maitenes | Chile | 1901 | 1,000,000 |
| 132 | Compania de Maipu | Chile | 1901 | 1,000,000 |
| 133 | New York & Nevada | Nevada, U. S. A. | 1902 | 1,000,000 |
| 134 | New York & Virginia | Virginia, U. S. A. | 1902 | 1,000,000 |
| 135 | Nichols Chemical Co. | Canada | 1902 | 1,000,000 |
| 136 | Puquios | Chile | 1901 | 1,000,000 |
| 137 | Panuco | Chile | 1902 | 1,000,000 |
| 138 | Queensland | Australia | 1902 | 1,000,000 |
| 139 | Rambler | Wyoming, U. S. A. | 1902 | 1,000,000 |
| 140 | Rio Tinto Mexicana | Mexico | 1902 | 1,000,000 |
| 141 | Santa Fe | New Mexico, U.S.A. | 1901 | 1,000,000 |
| 142 | Capanne Vecchie e Poggio Bindo | Italy | 1901 | 1,000,000 |
| 143 | Blayney | Australia | 1901 | 936,320 |
| 144 | Mond Nickel Co. | Canada | 1901 | 917,600 |

### PRODUCTION OF VARIOUS MINES. (Continued.)

(*Pounds.*)

| No. | Mine or Company. | Location. | Year. | Product. |
|---|---|---|---|---|
| 145 | Omodani | Japan | 1900 | 896,000 |
| 146 | United Globe | Arizona, U. S. A. | 1901 | 830,400 |
| 147 | Chillagoe | Australia | 1901 | 822,080 |
| 148 | Centennial | Michigan, U. S. A. | 1901 | 806,400 |
| 149 | Pitkaranta | Finland | 1897 | 760,560 |
| 150 | War Eagle | Canada | 1901 | 750,000 |
| 151 | Snowshoe | Canada | 1902 | 750,000 |
| 152 | Stora Kopparberg | Sweden | 1902 | 700,000 |
| 153 | Carreras Hermanos | Bolivia | 1901 | 675,000 |
| 154 | Soc. Española de Fundicion | Chile | 1901 | 675,000 |
| 155 | Broken Hill | Australia | 1901 | 675,000 |
| 156 | Girilambone | Australia | 1898 | 650,000 |
| 157 | Kargalinski | Russia | 1899 | 640,866 |
| 158 | Adventure | Michigan, U. S. A. | 1902 | 606,211 |
| 159 | F. de P. Perez | Chile | 1901 | 600,000 |
| 160 | Horn Silver | Utah, U. S. A. | 1901 | 577,578 |
| 161 | Ligure Ramifera | Italy | 1901 | 550,000 |
| 162 | Aamdal | Norway | 1895 | 537,600 |
| 163 | Rossland Great Western | Canada | 1902 | 525,000 |
| 164 | Gertrude | Canada | 1902 | 525,000 |
| 165 | Arcadian | Michigan, U. S. A. | 1902 | 600,000 |
| 166 | Utah & Eastern | Utah, U. S. A. | 1902 | 500,000 |
| 167 | Virginia Copper Co., Ltd | Virginia, U. S. A. | 1902 | 500,000 |
| 168 | Brixlegg | Austria | 1902 | 485,012 |
| 169 | Dzansulski | Russia | 1899 | 476,000 |
| 170 | Jose R. Espinoza | Chile | 1901 | 450,000 |
| 171 | Hampden | Australia | 1901 | 431,692 |
| 172 | Spence | California, U. S. A. | 1902 | 425,000 |
| 173 | Nafverberg | Sweden | 1901 | 375,000 |
| 174 | Cobar Chesney | Australia | 1901 | 336,000 |
| 175 | Geisse Hermanos | Chile | 1901 | 335,000 |
| 176 | South Tharsis | Tasmania | 1900 | 325,000 |
| 177 | Otto Harnecker | Chile | 1901 | 300,000 |
| 178 | New Mt. Hope | Australia | 1898 | 293,440 |
| 179 | Funatsu | Japan | 1901 | 275,000 |
| 180 | Hamley | Australia | 1901 | 250,000 |
| 181 | Seminole | Georgia, U. S. A. | 1902 | 250,000 |
| 182 | Lower Mammoth | Utah, U. S. A. | 1901 | 250,000 |
| 183 | Einasleigh | Australia | 1901 | 232,960 |
| 184 | Mohawk | Michigan, U. S. A. | 1902 | 226,824 |
| 185 | Quilomenco | Chile | 1901 | 225,000 |
| 186 | Francisco Vergara I | Chile | 1901 | 225,000 |
| 187 | Kafveltorps | Sweden | 1901 | 175,329 |
| 188 | Merisski | Russia | 1899 | 154,496 |
| 189 | Alverdski & Shamblurgski | Russia | 1899 | 152,660 |
| 190 | Great Freehold | Australia | 1901 | 150,000 |
| 191 | Atvidaberg | Sweden | 1901 | 134,412 |
| 192 | Michigan | Michigan, U. S. A. | 1902 | 133,373 |
| 193 | Papovski | Siberia | 1899 | 121,924 |
| 194 | Hecla Consolidated | Montana, U. S. A. | 1901 | 103,671 |
| 195 | Winona | Michigan, U. S. A. | 1902 | 101,188 |
| 196 | Dingo | Australia | 1901 | 100,000 |

## ESTIMATE OF WORLD'S PRODUCTION IN 1902.

In the following table are given actual figures of production for 1901 and an estimate, based upon the best obtainable data, of the outputs for 1902, final figures for which will not be at hand until the latter half of 1903. The estimated figures, while very close to the actual production in some cases, will be subject to considerable changes in other instances, and the table should be taken merely for what it purports to be—a forecast, based upon the best information at hand very early in 1903.

(*Long Tons.*)

| Country. | 1901. | 1902. |
|---|---|---|
| Argentina | 1,780 | 1,000 |
| Australasia | 30,875 | 27,000 |
| Austria | 1,015 | 1,500 |
| Bolivia | 2,000 | 2,400 |
| Canada | 18,800 | 21,000 |
| Cape Colony | 6,400 | 6,750 |
| Chile | 30,000 | 32,000 |
| Germany | 21,720 | 22,000 |
| Great Britain | 600 | 500 |
| Hungary | 320 | 300 |
| Italy | 3,000 | 3,000 |
| Japan | 27,475 | 27,500 |
| Mexico | 23,795 | 40,000 |
| Newfoundland | 2,000 | 2,000 |
| Norway | 3,375 | 3,500 |
| Peru | 9,520 | 7,500 |
| Russia | 8,000 | 8,000 |
| Sweden | 450 | 500 |
| Spain & Portugal | 53,621 | 54,000 |
| Turkey | 980 | 1,000 |
| United States | 272,609 | 293,504 |
| Totals | 515,609 | 554,954 |

Estimated increase of the United States, 7.6%; for all countries other than the United States, 10.0%; for the entire world, 8.8%.

## AMERICAN COPPER PRODUCTION.

1850–1901.
(*Long Tons.*)

| Year. | United States Total Production | Michigan Produc- tion | Michigan Per cent of total | Montana Produc- tion | Montana Per cent of total | Arizona Produc- tion | Arizona Per cent of total |
|---|---|---|---|---|---|---|---|
| 1850 | 650 | 572 | 88 | ....... | .. | ...... | .. |
| 1851 | 900 | 779 | 86 | ....... | .. | ...... | .. |
| 1852 | 1,100 | 792 | 72 | ....... | .. | ...... | .. |
| 1853 | 2,000 | 1,297 | 65 | ....... | .. | ...... | .. |
| 1854 | 2,250 | 1,819 | 81 | ....... | .. | ...... | .. |
| 1855 | 3,000 | 2,593 | 86 | ....... | .. | ...... | .. |
| 1856 | 4,000 | 3,666 | 91 | ....... | .. | ...... | .. |
| 1857 | 4,800 | 4,255 | 88 | ....... | .. | ...... | .. |
| 1858 | 5,500 | 4,088 | 74 | ....... | .. | ...... | .. |
| 1859 | 6,300 | 3,985 | 63 | ....... | .. | ...... | .. |
| 1860 | 7,200 | 5,388 | 74 | ....... | .. | ...... | .. |
| 1861 | 7,500 | 6,713 | 89 | ....... | .. | ...... | .. |
| 1862 | 9,000 | 6,065 | 67 | ....... | .. | ...... | .. |
| 1863 | 8,500 | 5,797 | 68 | ....... | .. | ...... | .. |
| 1864 | 8,000 | 5,576 | 69 | ....... | .. | ...... | .. |
| 1865 | 8,500 | 6,410 | 75 | ....... | .. | ...... | .. |
| 1866 | 8,900 | 6,138 | 69 | ....... | .. | ...... | .. |
| 1867 | 10,000 | 7,824 | 78 | ....... | .. | ...... | .. |
| 1868 | 11,600 | 9,346 | 80 | ....... | .. | ...... | .. |
| 1869 | 12,500 | 11,886 | 95 | ....... | .. | ...... | .. |
| 1870 | 12,600 | 10,992 | 87 | ....... | .. | ...... | .. |
| 1871 | 13,000 | 11,942 | 91 | ....... | .. | ...... | .. |
| 1872 | 12,500 | 10,961 | 87 | ....... | .. | ...... | .. |
| 1873 | 15,500 | 13,433 | 86 | ....... | .. | ...... | .. |
| 1874 | 17,500 | 15,327 | 87 | ....... | .. | ...... | .. |
| 1875 | 18,000 | 16,089 | 89 | ....... | .. | ...... | .. |
| 1876 | 19,000 | 17,085 | 89 | ....... | .. | ...... | .. |
| 1877 | 21,000 | 17,422 | 83 | ....... | .. | ...... | .. |
| 1878 | 21,500 | 17,719 | 82 | ....... | .. | ...... | .. |
| 1879 | 23,000 | 19,129 | 83 | ....... | .. | ...... | .. |
| 1880 | 27,000 | 22,204 | 82 | ....... | .. | ...... | .. |
| 1881 | 32,000 | 24,363 | 76 | ....... | .. | ...... | .. |
| 1882 | 40,467 | 25,439 | 62 | ....... | .. | ...... | .. |
| 1883 | 51,574 | 26,653 | 51 | 11,011 | 21 | 10,658 | 21 |
| 1884 | 64,708 | 30,961 | 47 | 19,256 | 30 | 11,935 | 18 |
| 1885 | 74,052 | 32,209 | 43 | 30,267 | 41 | 10,137 | 14 |
| 1886 | 70,430 | 36,124 | 51 | 25,362 | 36 | 6,990 | 10 |
| 1887 | 81,017 | 33,941 | 42 | 35,133 | 43 | 7,910 | 10 |
| 1888 | 101,054 | 38,604 | 38 | 43,704 | 43 | 14,195 | 14 |
| 1889 | 101,239 | 39,364 | 38 | 43,849 | 43 | 13,654 | 13 |
| 1890 | 115,966 | 45,273 | 39 | 50,437 | 43 | 15,534 | 13 |
| 1891 | 126,839 | 50,992 | 40 | 50,028 | 39 | 17,800 | 14 |
| 1892 | 154,018 | 54,999 | 36 | 72,860 | 47 | 17,160 | 11 |
| 1893 | 147,033 | 50,270 | 34 | 69,290 | 47 | 19,200 | 13 |
| 1894 | 158,120 | 51,031 | 32 | 81,729 | 52 | 19,873 | 13 |
| 1895 | 169,917 | 57,737 | 34 | 84,900 | 50 | 21,408 | 13 |
| 1896 | 205,384 | 63,418 | 31 | 99,071 | 48 | 32,560 | 16 |
| 1897 | 220,571 | 63,706 | 29 | 102,807 | 47 | 36,398 | 17 |
| 1898 | 235,050 | 66,056 | 28 | 92,041 | 39 | 49,624 | 21 |
| 1899 | 253,870 | 65,603 | 26 | 100,503 | 40 | 59,399 | 23 |
| 1900 | 269,111 | 63,461 | 24 | 120,865 | 45 | 52,820 | 20 |
| 1901 | 268,522 | 69,501 | 26 | 102,620 | 38 | 58,383 | 22 |

## UNITED STATES COPPER PRODUCTION BY STATES.

1898–1901.

| State. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|
| Montana | 206,173,157 | 225,126,855 | 270,738,489 | 229,870,415 |
| Michigan | 147,965,738 | 146,950,338 | 142,153,171 | 155,716,848 |
| Arizona | 111,158,246 | 133,054,860 | 118,317,764 | 130,778,611 |
| California | 16,925,634 | 26,221,897 | 28,511,225 | 33,667,456 |
| Utah | 3,750,000 | 9,584,746 | 18,354,726 | 20,116,979 |
| Colorado | 16,274,561 | 11,643,608 | 7,826,949 | 9,801,783 |
| East and South | 5,395,226 | 4,410,554 | 4,820,495 | 6,860,039 |
| New Mexico | 1,592,371 | 3,935,441 | 4,169,400 | 9,629,884 |
| Wyoming | 233,044 | 3,104,827 | 4,203,776 | 2,698,712 |
| South Dakota | 1,261,393 | 17,020 | 15,147 | 753,510 |
| Nevada | 437,396 | 556,775 | 407,535 | 593,608 |
| Idaho | 1,266,920 | 110,000 | 290,162 | 480,511 |
| Miscellaneous | 3,553,336 | 3,500,000 | 3,000,000 | 531,530 |
| Total domestic | 516,187,022 | 568,216,921 | 602,808,839 | 601,499,886 |
| From imported ores and matte | 19,750,000 | 23,800,000 | 36,380,000 | 64,000,000 |
| Gross Production | 535,737,022 | 592,016,921 | 639,188,839 | 665,499,886 |

## LAKE SUPERIOR COPPER PRODUCTION BY MINES.

1899–1902.

The figures for 1902 are mainly official, but partly estimated, while figures for preceding years are official, and give exact returns, in all cases except the few figures prefaced by an asterisk, in which cases no returns have been made by the mines for the years in question.

(*Pounds Avoirdupois.*)

| Mines. | 1902. | 1901. | 1900. | 1899. |
|---|---|---|---|---|
| Calumet & Hecla | 81,248,739 | 82,519,676 | 77,761,382 | 89,610,963 |
| Quincy | 18,988,491 | 20,540,720 | 14,116,551 | 14,301,182 |
| Tamarack | 17,500,000 | 18,000,852 | 19,182,502 | 18,565,602 |
| Osceola | 13,416,396 | 13,723,487 | 12,566,471 | 11,358,049 |
| Wolverine | 6,473,181 | 4,946,126 | 4,789,829 | 4,500,373 |
| Baltic | 6,285,819 | 2,641,432 | 1,735,060 | 621,336 |
| Trimountain | 6,000,000 | ........ | ........ | ........ |
| Franklin | 5,259,140 | 3,757,419 | 3,663,710 | 1,230,000 |
| Atlantic | 4,949,366 | 4,666,880 | 4,930,149 | 4,675,882 |
| Champion | 4,165,784 | ........ | ........ | ........ |
| Isle Royale | 3,569,748 | 2,171,955 | ........ | ........ |
| Mass | 2,345,805 | *950,000 | 122,239 | 42,800 |
| Adventure | 606,211 | 29,361 | 23,572 | ........ |
| Arcadian | 600,000 | *500,000 | 1,350,000 | 500,000 |
| Mohawk | 226,824 | 160,897 | ........ | ........ |
| Michigan | 133,373 | 806,400 | 892,500 | 730,240 |
| Winona | 101,188 | 108,000 | 856,000 | 763,911 |
| Phoenix | 100,000 | 93,643 | 88,206 | ........ |
| Miscellaneous | 650,000 | 50,000 | 73,400 | 50,000 |
| Totals | 172,620,065 | 155,716,848 | 142,151,571 | 146,950,338 |

## PRODUCTION, VALUE AND DIVIDENDS OF LAKE COPPER.

1845–1902.

| Year. | Gross Product fine copper (Pounds). | Gross value of production (Dollars). | Total Dividends paid (Dollars). | Percentage of dividends to gross values. | Dividends per pound of copper (Cents). |
|---|---|---|---|---|---|
| 1845.... | 24,880 | 5,000 | .......... | .... | ..... |
| 1846.... | 58,240 | 10,000 | .......... | .... | ..... |
| 1847.... | 297,120 | 55,000 | .......... | .... | ..... |
| 1848.... | 1,032,640 | 200,900 | .......... | .... | ..... |
| 1849.... | 1,505,280 | 336,000 | 60,000 | 17.0 | 3.98 |
| 1850.... | 1,281,280 | 286,000 | 84,000 | 29.0 | 6.55 |
| 1851.... | 1,744,960 | 289,500 | 60,000 | 12.0 | 3.43 |
| 1852.... | 1,774,080 | 396,000 | 60,000 | 15.0 | 3.38 |
| 1853.... | 2,905,280 | 648,500 | 90,000 | 14.0 | 3.09 |
| 1854.... | 4,074,560 | 909,500 | 198,000 | 21.0 | 4.85 |
| 1855.... | 5,809,334 | 1,586,160 | 168,000 | 10.0 | 2.89 |
| 1856.... | 8,217,392 | 2,218,320 | 380,000 | 17.0 | 4.62 |
| 1857.... | 9,530,830 | 2,382,500 | 480,000 | 20.0 | 5.03 |
| 1858.... | 9,159,916 | 2,129,235 | 460,000 | 21.0 | 5.00 |
| 1859.... | 8,937,995 | 1,950,355 | 360,000 | 18.0 | 4.02 |
| 1860.... | 12,068,375 | 2,654,960 | 120,000 | 5.0 | 0.99 |
| 1861.... | 15,182,837 | 3,487,995 | 260,000 | 7.0 | 1.70 |
| 1862.... | 13,586,318 | 3,634,255 | 440,000 | 12.0 | 3.23 |
| 1863.... | 12,985,444 | 4,415,600 | 720,000 | 16.0 | 5.54 |
| 1864.... | 12,491,965 | 5,870,300 | 1,150,000 | 19.0 | 9.20 |
| 1865.... | 14,358,592 | 5,635,515 | 510,000 | 9.0 | 3.55 |
| 1866.... | 13,750,063 | 4,629,375 | 170,000 | 3.7 | 1.23 |
| 1867.... | 17,515,607 | 4,442,841 | 110,000 | 2.4 | 0.63 |
| 1868.... | 20,934,124 | 4,940,424 | 100,000 | 2.0 | 0.47 |
| 1869.... | 26,625,301 | 6,230,016 | 210,000 | 3.4 | 0.78 |
| 1870.... | 24,622,759 | 5,096,752 | 700,000 | 13.0 | 2.84 |
| 1871.... | 25,746,448 | 5,728,485 | 1,640,000 | 29.0 | 6.36 |
| 1872.... | 24,553,523 | 7,979,400 | 3,080,000 | 38.0 | 11.54 |
| 1873.... | 30,291,505 | 8,726,100 | 2,330,000 | 27.0 | 7.69 |
| 1874.... | 34,334,389 | 8,009,356 | 1,940,000 | 24.0 | 5.06 |
| 1875.... | 36,039,497 | 8,180,625 | 1,920,000 | 23.0 | 5.32 |
| 1876.... | 38,270,997 | 7,998,430 | 1,870,000 | 23.0 | 4.88 |
| 1877.... | 39,026,671 | 7,327,880 | 1,840,000 | 25.0 | 4.71 |
| 1878.... | 41,687,266 | 6,920,540 | 1,860,000 | 27.0 | 4.46 |
| 1879.... | 42,671,529 | 7,327,350 | 1,818,620 | 25.0 | 4.26 |
| 1880.... | 49,718,337 | 9,947,673 | 3,080,000 | 30.9 | 6.19 |
| 1881.... | 54,548,909 | 9,971,702 | 2,665,000 | 26.7 | 4.88 |
| 1882.... | 57,155,980 | 10,522,416 | 2,850,000 | 27.1 | 4.99 |
| 1883.... | 59,702,404 | 9,457,853 | 2,670,000 | 28.1 | 4.47 |
| 1884.... | 69,353,202 | 9,494,306 | 1,327,500 | 12.9 | 1.91 |
| 1885.... | 72,147,889 | 7,942,597 | 1,970,000 | 24.8 | 2.73 |
| 1886.... | 80,918,460 | 8,788,476 | 1,900,000 | 21.5 | 2.34 |
| 1887.... | 76,028,697 | 8,530,342 | 1,370,000 | 16.1 | 1.80 |
| 1888.... | 86,472,034 | 14,510,001 | 3,260,000 | 22.4 | 3.77 |
| 1889.... | 88,175,675 | 11,894,942 | 2,670,000 | 22.4 | 3.03 |
| 1890.... | 101,410,277 | 15,819,960 | 3,415,000 | 21.6 | 3.36 |
| 1891.... | 114,222,709 | 14,574,727 | 3,540,000 | 24.3 | 3.10 |
| 1892.... | 123,198,460 | 12,431,624 | 3,260,000 | 26.2 | 2.64 |
| 1893.... | 112,605,078 | 12,105,145 | 3,520,000 | 29.1 | 3.12 |
| 1894.... | 114,308,870 | 10,852,122 | 2,380,000 | 21.9 | 2.08 |
| 1895.... | 129,330,749 | 13,877,109 | 3,280,000 | 23.6 | 2.54 |
| 1896.... | 142,057,500 | 15,758,935 | 3,985,000 | 25.3 | 2.80 |
| 1897.... | 142,702,586 | 16,530,843 | 5,431,000 | 32.8 | 3.80 |

## PRODUCTION, VALUE AND DIVIDENDS OF LAKE COPPER. (Continued.)

1845-1902.

| Year. | Gross Product fine copper (Pounds). | Gross value of production (Dollars). | Total Dividends paid (Dollars). | Percentage of dividends to gross values. | Dividends per pound of copper (Cents). |
|---|---|---|---|---|---|
| 1898.... | 147,965,738 | 17,829,871 | 6,857,250 | 38.4 | 4.63 |
| 1899.... | 146,950,338 | 26,098,382 | 12,318,450 | 47.2 | 8.39 |
| 1900.... | 142,151,571 | 23,691,928 | 9,811,200 | 41.3 | 6.90 |
| 1901.... | 155,716,848 | 26,038,857 | 7,496,900 | 28.8 | 4.81 |
| Totals.. | 2,809,246,715 | 439 098,089 | 114,245,920 | 26.0 | 4.05 |
| 1902.... | *172,620,065 | *20,088,320 | 3,440,000 | *17.1 | 1.99 |

* Estimated.

## AMERICAN COPPER EXPORTS.

1864-1901.

The United States government estimates of exports of copper, including ingot and various forms of refined copper, matte, blister copper and ores, and manufactured products, from 1864 until 1901, inclusive, are as follows:

(*Cwts. and Pounds.*)

| Year Ending— | Ore and Matte. Cwts. | Refined. Pounds. | Total Value. |
|---|---|---|---|
| June 30, 1864........ | 109,581 | 102,831 | $ 432,570 |
| 1865........ | 225,197 | 1,572,382 | 1,544,870 |
| 1866........ | 215,080 | 123,444 | 936,211 |
| 1867........ | 87,731 | 4,637,867 | 791,901 |
| 1868........ | 92,612 | 1,350,896 | 922,409 |
| 1869........ | 121,418 | 1,134,360 | 592,698 |
| 1870........ | 19,198 | 2,214,658 | 1,042,246 |
| 1871........ | 54,445 | 581,650 | 915,431 |
| 1872........ | 35,564 | 267,868 | 287,735 |
| 1873........ | 45,252 | 38,958 | 259,076 |
| 1874........ | 13,326 | 503,160 | 467,208 |
| 1875........ | 51,305 | 5,123,470 | 1,815,266 |
| 1876........ | 15,304 | 14,304,160 | 3,526,410 |
| 1877........ | 21,432 | 13,461,553 | 3,023,394 |
| 1878........ | 32,947 | 11,297,876 | 2,488,921 |
| 1879........ | 23,070 | 17,207,739 | 2,933,205 |
| 1880........ | 21,623 | 4,206,258 | 849,218 |
| 1881........ | 9,958 | 4,865,407 | 876,395 |
| 1882........ | 25,936 | 3,340,531 | 748,456 |
| 1883........ | 112,923 | 8,221,363 | 2,348,004 |
| 1884........ | 386,140 | 17,044,760 | 5,595,859 |
| 1885........ | 432,300 | 44,731,858 | 10,187,024 |
| Dec. 31, 1886........ | 417,520 | 19,553,421 | 4,380,322 |
| 1887........ | 501,280 | 12,471,393 | 4,114,456 |
| 1888........ | 794,960 | 31,706,527 | 11,897,240 |
| 1889........ | 818,500 | 16,813,410 | 10,209,722 |
| 1890........ | 431,411 | 10,971,899 | 5,918,395 |
| 1891........ | 672,120 | 69,279,024 | 15,703,543 |
| 1892........ | 943,040 | 30,515,736 | 10,162,870 |
| 1893........ | 835,040 | 138,984,128 | 18,935,497 |
| 1894........ | 87,040 | 162,393,000 | 16,143,094 |
| 1895........ | 276,480 | 121,328,390 | 14,938,309 |
| 1896........ | 414,265 | 259,223,924 | 31,035,211 |
| 1897........ | 181,280 | 277,255,742 | 32,755,053 |
| 1898........ | 186,860 | 291,955,905 | 35,515,251 |
| 1899........ | 74,540 | 246,826,331 | 43,485,654 |
| 1900........ | 200,140 | 337,973,751 | 58,875,439 |
| 1901........ | 292,260 | 194,249,828 | 36,071,448 |

## AMERICAN EXPORTS OF REFINED COPPER.

1893–1902.

The following figures, showing American exports of copper, in long tons, from 1893 to 1902, inclusive, are furnished by Mr. John Stanton, of New York, secretary of the American Copper Producers' Association:

(*Long Tons.*)

| Year | Exports. |
|---|---|
| 1893 | 80,392 |
| 1894 | 77,527 |
| 1895 | 64,722 |
| 1896 | 125,605 |
| 1897 | 129,210 |
| 1898 | 145,115 |
| 1899 | 119,811 |
| 1900 | 160,082 |
| 1901 | 94,366 |
| 1902 | 164,451 |

## AMERICAN EXPORTS BY PORTS.

1898–1901.

(*Pounds.*)

| Port of Export. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|
| Baltimore | 87,027,133 | 90,786,853 | 86,264,231 | 54,377,355 |
| Boston | 439,368 | 1,568,197 | 1,496,387 | 27,917 |
| Newark, N. J. | 673,180 | .......... | .......... | .......... |
| Newport News, Va. | 2,638,868 | 4,085,580 | 2,016,000 | 1,568,567 |
| Norfolk, Va. | 5,249,820 | 4,707,267 | .......... | .......... |
| New York | 178,400,314 | 134,412,540 | 230,178,643 | 133,540,150 |
| Philadelphia | 68,624 | 2,733,692 | 12,468,680 | 3,526,130 |
| New Orleans | 15,508,831 | 7,459,623 | 3,937,350 | 1,806 |
| Galveston, Tex. | 444,920 | 3,700 | .......... | .......... |
| Detroit | 728,689 | 320,121 | 469,819 | 387,923 |
| Port Huron, Mich. | 118,827 | 107,562 | 149,525 | 92,062 |
| Burlington, Vt | 410,410 | 434,340 | 678,589 | 434,692 |
| Miscellaneous | 246,921 | 206,856 | 314,527 | 293,226 |
| Totals | 291,955,905 | 246,826,331 | 337,973,751 | 194,249,828 |

## AMERICAN COPPER EXPORTS BY DESTINATIONS.

1898–1901.

(*Pounds.*)

| Destination. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|
| Great Britain and Ireland | 88,443,870 | 50,675,849 | 63,522,445 | 36,819,100 |
| Holland | 72,418,633 | 69,304,669 | 101,398,394 | 61,752,002 |
| France | 59,630,864 | 53,909,508 | 67,725,989 | 34,607,042 |
| Germany | 42,891,345 | 49,285,139 | 67,348,848 | 37,487,180 |
| Belgium | 13,613,183 | 5,069,456 | 12,554,191 | 4,561,405 |
| Austria-Hungary | 7,478,730 | 6,354,287 | 11,258,115 | 8,616,964 |
| Russia | 7,340,276 | 2,689,610 | 5,650,423 | 2,889,270 |
| Italy | 3,733,672 | 3,449,565 | 5,550,285 | 5,045,775 |
| Other Countries | 2,126,688 | 1,546,860 | 2,965,061 | 2,471,090 |
| Totals | 291,955,905 | 246,826,331 | 337,973,751 | 194,249,828 |

## AMERICAN IMPORTS OF COPPER.

1890–1901.

The following table showing imports of copper into the United States, in various forms, is summarized from the official figures of the United States government. The figures are somewhat unsatisfactory, for the reason that after and including 1895 the figures of ore are for gross weight of imported ore, while for preceding years the figures are for copper contents of the ore:

(*Pounds.*)

| Year. | Ore. | Copper in Matte. | Raw Copper. | Old Copper. | Estimated Total. |
|---|---|---|---|---|---|
| 1890... | 3,448,237 | 221,838 | 5,189 | 284,789 | 3,960,053 |
| 1891... | 8,931,554 | 2,403,919 | 2,556 | 134,407 | 11,472,436 |
| 1892... | 7,669,978 | 303,087 | 22,097 | 71,485 | 8,066,647 |
| 1893... | 7,256,015 | 3,175,559 | 554,348 | 59,375 | 11,045,297 |
| 1894... | 4,804,614 | 5,873,820 | 606,415 | 160,592 | 11,445,441 |
| 1895... | *a*8,921,920 | *a*3,104,640 | 7,979,322 | 1,336,901 | .......... |
| 1896... | *a*2,620,800 | *a*3,427,200 | 9,074,379 | 2,422,554 | .......... |
| 1897... | *a*43,919,680 | 2,974,720 | 12,646,552 | 1,780,390 | 28,923,098 |
| 1898.... | *a*107,253,440 | 1,583,680 | 5,892,944 | 1,986,133 | 73,916 467 |
| 1899... | *a*120,934,616 | 7,763,885 | 64,282,583 | 6,678,145 | 95,722,340 |
| 1900... | *a*109,123,840 | 27,534,080 | 62,404,489 | 3,354,756 | 105,176,808 |
| 1901... | *a*131,790,400 | 75,913,600 | 71,001,713 | 2,818,757 | 137,826,406 |

*a. Gross weight of ore.*

## COPPER IMPORTED FOR AMERICAN CONSUMPTION.

1890–1901.

Of the copper imported into the United States, 1890-1901, inclusive, the following amounts have been entered at the custom-houses for American consumption:

(*Pounds.*)

| Year. | New Copper. | Old Copper. | Total. | Value. |
|---|---|---|---|---|
| 1890........ | 5,189 | 284,789 | 289,978 | $ 27,322 |
| 1891........ | 2,556 | 134,407 | 136,963 | 10,074 |
| 1892........ | 22,097 | 71,485 | 93,582 | 8,702 |
| 1893........ | 554,338 | 59,375 | 613,713 | 65,425 |
| 1894........ | 606,415 | 160,592 | 767,007 | 58,414 |
| 1895........ | 7,979,322 | 1,336,901 | 9,316,223 | 836,687 |
| 1896........ | 9,074,379 | 2,422,554 | 11,496,933 | 947,395 |
| 1897........ | 12,646,552 | 1,780,390 | 14,426,942 | 1,301,355 |
| 1898........ | 35,892,944 | 1,986,133 | 37,879,077 | 3,262,946 |
| 1899........ | 64,282,583 | 6,678,145 | 70,960,728 | 10,108,592 |
| 1900........ | 62,404,489 | 3,354,756 | 65,759,245 | 10,305,016 |
| 1901........ | 71,001,713 | 2,818,757 | 73,820,470 | 11,804,281 |

## AMERICAN COPPER SUPPLY.

1892–1901.

(*Pounds.*)

| Year. | Domestic Produc'n. | Imports. | Total Supply. | Exports. | Net Supply. |
|---|---|---|---|---|---|
| 1892... | 344,998,679 | 8,066,647 | 353,065,326 | 96,515,736 | 256,549,590 |
| 1893... | 329,354,398 | 11,045,297 | 340,399,695 | 188,984,128 | 151,415,567 |
| 1894... | 354,188,374 | 11,445,441 | 365,633,815 | 168,143,000 | 197,490,815 |
| 1895... | 380,613,404 | 14,616,223 | 395,229,627 | 136,528,390 | 258,701,237 |
| 1896... | 460,061,430 | 17,297,272 | 477,358,702 | 282,105,860 | 195,252,842 |
| 1897... | 494,078,274 | 28,578,420 | 522,656,694 | 288,662,340 | 233,994,354 |
| 1898... | 526,512,987 | 73,916,467 | 600,429,454 | 321,023,873 | 279,405,581 |
| 1899... | 568,666,921 | 95,722,340 | 664,389,261 | 252,876,480 | 411,512,781 |
| 1900... | 606,117,166 | 105,176,808 | 711,293,974 | 348,402,853 | 362,891,121 |
| 1901... | 602,072,519 | 137,826,406 | 739,898,925 | 222,137,911 | 517,761,014 |

## AMERICAN COPPER TRADE.

1892–1901.

This table, compiled by the Metallegesellschaft & Metallurgische Gesellschaft A.-G., of Frankfort-on-Main, Germany, is based upon the official statistics of the United States government. The production, given in the first column, includes copper produced from imported ores and matte, as well as copper from domestic ore and regulus:

(*Metric Tons.*)

| Year. | Production. | Imports. | Exports. | Supply. |
|---|---|---|---|---|
| 1892 | 151,163 | 784 | 43,004 | 108,943 |
| 1893 | 152,272 | 2,512 | 87,492 | 67,292 |
| 1894 | 164,095 | 1,563 | 77,089 | 88,569 |
| 1895 | 178,341 | 4,253 | 63,759 | 118,835 |
| 1896 | 219,328 | 5,186 | 128,548 | 95,966 |
| 1897 | 230,185 | 7,543 | 131,730 | 105,998 |
| 1898 | 250,000 | 24,646 | 150,721 | 123,925 |
| 1899 | 273,000 | 32,516 | 116,629 | 188,887 |
| 1900 | 283,000 | 31,303 | 160,403 | 153,900 |
| 1901 | 297,900 | 33,600 | 110,500 | 221,000 |

## BRITISH AND FRENCH STOCKS OF COPPER.

1888–1903.

The following table gives the estimates of stocks of refined copper on hand in Great Britain and France, on the first day of January of each year named. The first column gives actual stocks on hand, the second column giving the "visible supply," which in addition to stocks on hand includes shipments afloat from Chile and Australia to European ports:

(*Long Tons.*)

| Year. | Public Stocks. | Visible Supply. |
|---|---|---|
| 1888 | 35,001 | ...... |
| 1889 | 96,194 | 104,091 |
| 1890 | 94,942 | 98,847 |
| 1891 | 62,449 | 65,366 |
| 1892 | 53,486 | ...... |
| 1893 | 51,556 | ...... |
| 1894 | 43,428 | ...... |
| 1895 | 51,575 | ...... |
| 1896 | 43,604 | 45,817 |
| 1897 | 31,776 | 34,927 |
| 1898 | 27,895 | 31,955 |
| 1899 | 22,702 | ...... |
| 1900 | 17,797 | ...... |
| 1901 | 24,845 | 28,921 |
| 1902 | 15,701 | 22,003 |
| 1903 | 11,215 | 16,540 |

## ENGLISH COPPER TRADE.

1860–1901.

(*Long Tons.*)

| Year. | Imports | | | Exports. | Apparent Consumption. |
|---|---|---|---|---|---|
| | Copper. | Ore and Matte. | Total. | | |
| 1860........ | 13,142 | 13,715 | 26,857 | 26,117 | ...... |
| 1865........ | 23,137 | 23,922 | 47,059 | 41,398 | ...... |
| 1870........ | 30,724 | 27,025 | 57,749 | 53,006 | ...... |
| 1871........ | 33,228 | 23,671 | 56,899 | 56,633 | ...... |
| 1872........ | 49,000 | 21,702 | 70,702 | 53,195 | ...... |
| 1873........ | 35,840 | 26,756 | 62,596 | 55,716 | ...... |
| 1874........ | 39,906 | 27,894 | 67,800 | 59,742 | ...... |
| 1875........ | 41,931 | 29,483 | 71,414 | 51,870 | ...... |
| 1876........ | 39,145 | 36,191 | 75,336 | 52,468 | ...... |
| 1877........ | 39,743 | 53,582 | 93,325 | 54,088 | ...... |
| 1878........ | 39,360 | 48,212 | 87,572 | 55,001 | ...... |
| 1879........ | 46,670 | 50,421 | 97,091 | 62,412 | 30,774 |
| 1880........ | 36,509 | 56,225 | 92,734 | 59,482 | 32,879 |
| 1881........ | 32,170 | 54,057 | 86,227 | 61,689 | 31,607 |
| 1882........ | 35,509 | 58,366 | 93,875 | 55,683 | 42,877 |
| 1883........ | 35,653 | 63,493 | 99,146 | 59,350 | 40,469 |
| 1884........ | 39,767 | 69,623 | 109,390 | 64,691 | 51,263 |
| 1885........ | 41,933 | 81,616 | 123,549 | 62,080 | 54,323 |
| 1886........ | 42,969 | 65,046 | 108,015 | 60,511 | 41,158 |
| 1887........ | 29,198 | 73,891 | 103,089 | 69,453 | 53,096 |
| 1888........ | 44,063 | 90,867 | 135,470 | *a*72,066 | 42,562 |
| 1889........ | *b*38,576 | 101,407 | 139,983 | 75,627 | 65,759 |
| 1890........ | *c*49,461 | 91,788 | 141,249 | 89,747 | 66,170 |
| 1891........ | 44,213 | 94,403 | 138,616 | 76,056 | 59,223 |
| 1892........ | *d*35,015 | 99,356 | 134,371 | 82,542 | *e*48,367 |
| 1893........ | 41,829 | 88,003 | 129,832 | 70,986 | 66,817 |
| 1894........ | 56,157 | 68,851 | 125,008 | 54,689 | *f*50,330 |
| 1895........ | 42,135 | 77,806 | 119,941 | 65,990 | *f*50,692 |
| 1896........ | 60,458 | 75,398 | 135,856 | 59,334 | *f*76,036 |
| 1897........ | 60,428 | 76,127 | 136,555 | 56,542 | *f*69,787 |
| 1898........ | 67,978 | 71,726 | 139,704 | 63,256 | *f*69,284 |
| 1899........ | 58,880 | 82,730 | 141,610 | 75,271 | *f*60,877 |
| 1900........ | 70,247 | 84,694 | 154,941 | 56,997 | *f*81,896 |
| 1901........ | 66,764 | 82,814 | 149,578 | 70,396 | *f*70,178 |

*a. Including* 22,557 *tons of Chile bars transferred to France.*
*b. Including* 1,166 *tons of Chile bars transferred from France to England.*
*c. Including* 3,501 *tons of Chile bars transferred from France to England.*
*d. Including* 3,585 *tons of Chile bars transferred from France to England.*
*e. Add* 4,001 *tons for comparison with former years, the difference arising from the new method of making up stock.*
*f. Deducting copper contents of sulphate exported* (13,078 *tons in* 1898, 10,045 *tons in* 1899, 10,728 *tons in* 1900 *and* 9,004 *tons in* 1901).

## GERMAN COPPER TRADE.

1884–1901.

(Compiled by Metallegesellschaft & Metallurgische Gesellschaft A.-G.)

(*Metric Tons.*)

| Year. | Production. | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1884 | 18,113 | 13,819 | 6,906 | 25,026 |
| 1885 | 19,928 | 13,168 | 5,706 | 27,390 |
| 1886 | 19,314 | 11,913 | 6,510 | 24,717 |
| 1887 | 20,192 | 12,427 | 5,154 | 27,465 |
| 1888 | 21,017 | 8,082 | 4,530 | 24,569 |
| 1889 | 24,160 | 29,643 | 7,135 | 46,668 |
| 1890 | 24,427 | 31,408 | 8,428 | 47,407 |
| 1891 | 24,092 | 34,182 | 6,247 | 52,027 |
| 1892 | 24,781 | 32,498 | 6,598 | 50,681 |
| 1893 | 24,011 | 38,455 | 7,517 | 54,949 |
| 1894 | 25,722 | 37,032 | 6,609 | 56,145 |
| 1895 | 25,777 | 44,365 | 6,329 | 63,813 |
| 1896 | 29,319 | 56,115 | 5,996 | 79,438 |
| 1897 | 29,408 | 67,573 | 7,183 | 89,798 |
| 1898 | 30,695 | 73,291 | 6,972 | 97,014 |
| 1899 | 34,634 | 70,091 | 7,061 | 97,664 |
| 1900 | 30,929 | 83,503 | 5,505 | 108,927 |
| 1901 | 31,376 | 58,620 | 5,091 | 84,905 |

## FRENCH COPPER TRADE.

1892–1901.

(*Metric Tons.*)

| Year. | Production | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1892 | 6,400 | 24,154 | 2,116 | 28,438 |
| 1893 | 6,600 | 26,060 | 2,204 | 30,456 |
| 1894 | 6,400 | 26,756 | 2,467 | 30,689 |
| 1895 | 8,245 | 32,656 | 3,163 | 37,738 |
| 1896 | 6,544 | 40,136 | 3,456 | 43,224 |
| 1897 | 7,400 | 48,028 | 3,559 | 51,869 |
| 1898 | 7,834 | 45,575 | 4,044 | 49,365 |
| 1899 | 6,600 | 49,515 | 6,882 | 49,233 |
| 1900 | 6,400 | 51,962 | 5,736 | 52,626 |
| 1901 | 6,500 | 41,221 | 5,121 | 42,600 |

## AUSTRO-HUNGARIAN COPPER TRADE.

1892–1901.

(*Metric Tons.*)

| Year. | Production. | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1892 | 1,295 | 8,644 | 342 | 9,597 |
| 1893 | 1,396 | 11,822 | 434 | 12,784 |
| 1894 | 1,726 | 13,383 | 255 | 14,854 |
| 1895 | 1,276 | 11,747 | 151 | 12,872 |
| 1896 | 1,366 | 13,666 | 228 | 14,804 |
| 1897 | 1,426 | 15,926 | 159 | 17,193 |
| 1898 | 1,343 | 17,442 | 173 | 18,612 |
| 1899 | 1,479 | 16,185 | 534 | 17,130 |
| 1900 | 1,200 | 18,970 | 471 | 19,699 |
| 1901 | 1,350 | 17,433 | 425 | 18,358 |

## RUSSIAN COPPER TRADE.

1892–1901.

(*Metric Tons.*)

| Year. | Production. | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1892........ | 4,978 | 6,568 | .... | 11,546 |
| 1893........ | 5,100 | 8,756 | .... | 13,856 |
| 1894........ | 5,409 | 6,666 | .... | 12,075 |
| 1895........ | 5,854 | 8,100 | .... | 13,954 |
| 1896........ | 5,832 | 12,433 | .... | 18,265 |
| 1897........ | 6,941 | 12,507 | .... | 19,448 |
| 1898........ | 7,291 | 10,200 | .... | 17,491 |
| 1899........ | 7,533 | 6,300 | .... | 13,833 |
| 1900........ | 8,100 | 6,100 | .... | 14,200 |
| 1901........ | 8,100 | 6,000 | .... | 14,100 |

## ITALIAN COPPER TRADE.

1892–1901.

(*Metric Tons.*)

| Year. | Production | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1892........... | 2,564 | 2,139 | 168 | 4,535 |
| 1893........... | 2,371 | 3,043 | 157 | 5,257 |
| 1894........... | 2,670 | 3,706 | 32 | 6,344 |
| 1895........... | 2,375 | 4,350 | 84 | 6,641 |
| 1896........... | 2,842 | 4,509 | 383 | 6,968 |
| 1897........... | 2,980 | 5,032 | 222 | 7,790 |
| 1898........... | 3,230 | 5,028 | 462 | 7,796 |
| 1899........... | 3,032 | 6,006 | 1,355 | 7,683 |
| 1900........... | 2,797 | 6,224 | 676 | 8,345 |
| 1901........... | 3,000 | 5,982 | 100 | 8,882 |

## MISCELLANEOUS EUROPEAN COPPER TRADE.

1892–1901.

Sweden, Norway, Denmark, Switzerland, Spain, Portugal and Balkan states.

(Not including Spanish and Portuguese Production.)

(Compiled by Metallegesellschaft & Metallurgische Gesellschaft A.-G.)

(*Metric Tons.*)

| Year. | Production. | Imports. | Exports. | Consumption. |
|---|---|---|---|---|
| 1892.......... | 1,400 | 1,100 | 800 | 1,700 |
| 1893.......... | 1,600 | 1,400 | 1,000 | 2,000 |
| 1894.......... | 1,600 | 1,400 | 700 | 2,100 |
| 1895.......... | 1,500 | 1,400 | 1,100 | 1,800 |
| 1896.......... | 1,700 | 1,400 | 800 | 2,300 |
| 1897.......... | 1,700 | 1,500 | 1,200 | 2,000 |
| 1898.......... | 1,500 | 1,700 | 1,500 | 1,700 |
| 1899.......... | 2,300 | 1,800 | 2,100 | 2,000 |
| 1900.......... | 2,500 | 1,600 | 2,100 | 2,000 |
| 1901.......... | 3,200 | 2,000 | 2,600 | 2,600 |

## WORLD'S PRODUCTION OF RAW COPPER.

1895–1901.

The following table, prepared by the Metallegesellschaft & Metallurgische Gesellschaft A.-G., includes in the figures of production for each country the copper estimated to have been actually produced from native and imported ores, from impure raw copper brought in for refining, and from imported refined raw copper.

(*Metric Tons.*)

| Country. | 1895. | 1896. | 1897. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|---|---|---|
| United States | 170,100 | 208,800 | 224,800 | 242,900 | 270,100 | 277,000 | 281,600 |
| Great Britain | 78,246 | 76,000 | 75,000 | 69,500 | 79,100 | 80,000 | 80,000 |
| Germany | 25,777 | 29,319 | 29,408 | 30,695 | 34,634 | 30,929 | 31,376 |
| France | 8,245 | 6,544 | 7,400 | 7,834 | 6,600 | 6,400 | 6,500 |
| Austria-Hungary | 1,276 | 1,366 | 1,426 | 1,343 | 1,479 | 1,200 | 1,350 |
| Italy | 2,375 | 2,842 | 2,980 | 3,230 | 3,032 | 2,797 | 3,000 |
| Russia | 5,854 | 5,832 | 6,941 | 7,291 | 7,533 | 8,100 | 8,100 |
| Sweden & Norway | 1,500 | 1,700 | 1,700 | 1,500 | 2,300 | 2,500 | 3,200 |
| Chile | 19,609 | 18,900 | 18,000 | 18,000 | 17,100 | 19,800 | 23,400 |
| Japan | 11,500 | 9,000 | 11,300 | 12,400 | 21,000 | 19,300 | 20,900 |
| Australia | 8,100 | 8,232 | 10,400 | 14,700 | 16,800 | 17,400 | 19,900 |
| Japan & Australia Asiatic consumption | 8,000 | 13,300 | 14,100 | 13,700 | 9,000 | 10,100 | 8,000 |
| Mexico, Canada, etc. | 10,900 | 11,400 | 15,500 | 7,300 | 9,300 | 9,300 | 12,200 |
| Totals | 351,473 | 393,235 | 418,955 | 430,393 | 477,978 | 484,826 | 499,526 |

## WORLD'S CONSUMPTION OF RAW COPPER.

1895–1901.

(Compiled by Metallegesellschaft & Metallurgische Gesellschaft A.-G.)

(*Metric Tons.*)

| Country. | 1895. | 1896. | 1897. | 1898. | 1899. | 1900. | 1901. |
|---|---|---|---|---|---|---|---|
| United States | 118,835 | 95,966 | 105,998 | 123,925 | 188,887 | 153,900 | 221,000 |
| Great Britain | 91,551 | 116,674 | 109,531 | 104,373 | 86,528 | 108,782 | 105,243 |
| Germany | 63,813 | 79,438 | 89,798 | 97,014 | 97,664 | 108,927 | 84,905 |
| France | 38,174 | 43,224 | 51,869 | 49,552 | 49,233 | 52,626 | 42,600 |
| Austria-Hungary | 12,872 | 14,804 | 17,193 | 18,612 | 17,130 | 19,699 | 18,358 |
| Russia | 14,000 | 18,300 | 19,500 | 17,500 | 13,800 | 14,200 | 14,100 |
| Italy | 6,641 | 6,968 | 7,790 | 7,796 | 7,683 | 8,345 | 8,882 |
| Belgium | 5,000 | 5,500 | 6,200 | 5,800 | 5,500 | 6,250 | 6,500 |
| Netherlands | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 | 2,400 |
| Misc. European | 1,800 | 2,300 | 2,000 | 1,700 | 2,000 | 2,000 | 2,600 |
| Eastern Asia | 8,000 | 13,300 | 14,100 | 13,700 | 9,000 | 10,100 | 8,000 |
| Miscellaneous | 700 | 1,000 | 800 | 1,200 | 900 | 800 | 900 |
| Totals | 364,486 | 400,374 | 427,579 | 443,922 | 481,025 | 488,329 | 515,788 |

## MONTHLY PRICES OF LAKE SUPERIOR INGOT COPPER, 1860-1902.

*(January–June.)*

| Year. | January. | | February. | | March. | | April. | | May. | | June. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. |
| 1860.... | 24 | 23½ | 24 | 23¾ | 23¾ | 23 | 23½ | 23 | 23¼ | 22¾ | 22½ | 21¾ |
| 1861.... | 20 | 19 | 19½ | 19 | 19¾ | 19¼ | 19¾ | 19 | 19¾ | 19¼ | 19 | 18 |
| 1862.... | 28 | 27 | 28 | 25 | 25 | 23 | 23 | 21½ | 21½ | 20¾ | 23 | 20¾ |
| 1863.... | 35 | 31 | 37 | 35 | 37 | 31 | 31 | 30 | 30½ | 30 | 30½ | 30 |
| 1864.... | 41¼ | 39 | 42 | 41¼ | 42½ | 41½ | 44 | 42½ | 44 | 43 | 49 | 44 |
| 1865.... | 50½ | 46 | 46 | 44 | 44½ | 34 | 35 | 34 | 34 | 30 | 30½ | 28½ |
| 1866.... | 42 | 38 | 38 | 35½ | 35½ | 29½ | 30 | 28½ | 31 | 29 | 33 | 31 |
| 1867.... | 29¼ | 27 | 27¾ | 27½ | 27½ | 24 | 24½ | 23½ | 24¼ | 24 | 24½ | 24 |
| 1868.... | 23½ | 21½ | 24 | 22½ | 24 | 23¼ | 24¼ | 23¼ | 24¼ | 24 | 24 | 23½ |
| 1869.... | 26¼ | 23¾ | 27 | 26 | 26¾ | 24 | 24 | 23¼ | 24¼ | 23¾ | 23¾ | 22 |
| 1870.... | 22 | 21⅛ | 21¼ | 20⅞ | 20¾ | 19 | 19¾ | 19¼ | 19½ | 19 | 20⅜ | 19 |
| 1871.... | 22⅞ | 22 | 22⅝ | 21⅞ | 22 | 21⅜ | 21¾ | 21¼ | 21¾ | 21⅝ | 21½ | 21¼ |
| 1872.... | 28½ | 27⅛ | 28⅜ | 28¼ | 30½ | 28⅝ | 44 | 30½ | 42 | 36 | 34¾ | 33 |
| 1873.... | 35 | 32½ | 35 | 34 | 35 | 34½ | 34½ | 30½ | 33½ | 32 | 31½ | 29½ |
| 1874.... | 25 | 24½ | 25 | 24⅛ | 24¾ | 24 | 25 | 24¾ | 25 | 24½ | 24¾ | 24¼ |
| 1875.... | 23½ | 21½ | 22¾ | 21¾ | 21¾ | 21½ | 21¾ | 21½ | 23¼ | 22⅝ | 23 | 23 |
| 1876.... | 23¼ | 23 | 22⅞ | 22½ | 22¼ | 22 | 22⅝ | 22 | 22⅛ | 21 | 21 | 19¾ |
| 1877.... | 19½ | 19 | 20½ | 19½ | 19¼ | 19 | 19½ | 19¼ | 19¼ | 19 | 19⅝ | 19 |
| 1878.... | 17⅝ | 17¼ | 17½ | 17⅛ | 17⅛ | 16⅞ | 17 | 16⅞ | 16¾ | 16¼ | 16⅝ | 16¼ |
| 1879.... | 16 | 15½ | 15½ | 15½ | 15¾ | 15¾ | 16 | 15¾ | 16¼ | 16 | 16¼ | 16⅜ |
| 1880.... | 25 | 21⅝ | 24½ | 24 | 24 | 22¾ | 22½ | 21 | 21 | 18 | 18½ | 17¾ |
| 1881.... | 19⅜ | 19⅜ | 19⅜ | 19⅛ | 19⅜ | 19 | 19 | 18¾ | 18⅞ | 18¼ | 18¼ | 16⅝ |
| 1882.... | 20⅜ | 20¼ | 20 | 19 | 19¼ | 18⅞ | 18⅞ | 17⅞ | 18¼ | 18 | 18½ | 18 |
| 1883.... | 18⅛ | 18 | 17⅞ | 17¾ | 17⅝ | 17⅛ | 16 | 15¾ | 16 | 15⅞ | 15⅞ | 15 |
| 1884.... | 15 | 14⅞ | 15 | 14⅞ | 15 | 14⅞ | 15 | 14½ | 14½ | 14⅜ | 14¼ | 14 |
| 1885.... | 11½ | 10⅜ | 11⅞ | 10⅜ | 11⅛ | 10⅝ | 11¼ | 10 1/16 | 11½ | 10⅛ | 11½ | 11 |
| 1886.... | 11⅝ | 11⅜ | 11⅝ | 11⅜ | 11½ | 11⅜ | 11½ | 11⅜ | 11⅛ | 10 | 10¼ | 10 |
| 1887.... | 12 | 11⅛ | 11⅛ | 10⅛ | 10½ | 10⅜ | 10⅛ | 10 | 10 | 9 13/16 | 10¼ | 10 |
| 1888.... | 17⅜ | 15 15/16 | 16 9/16 | 16 | 16 7/16 | 15 13/16 | 16 9/16 | 16 | 16¾ | 16 9/16 | 16½ | 16 9/16 |
| 1889.... | 17½ | 16½ | 16¾ | 16½ | 15¾ | 15 | 16 | 15½ | 12¼ | 12 | 12 13/16 | 12 |
| 1890.... | 14½ | 14¼ | 14¼ | 14¼ | 14¼ | 14 | 14½ | 14¼ | 15¼ | 14⅝ | 16¾ | 15¼ |
| 1891.... | 15 | 14⅝ | 14⅞ | 14¼ | 14¼ | 13⅝ | 13¾ | 13½ | 13¾ | 12¾ | 13 | 12⅞ |
| 1892.... | 11 | 10¾ | 10¾ | 10½ | 12 | 10¾ | 12 | 11¾ | 12¼ | 12 | 11⅞ | 11⅜ |
| 1893.... | 12½ | 12¼ | 12¼ | 12 | 12 | 11¾ | 11½ | 11¼ | 11⅛ | 11 | 11 | 10⅜ |
| 1894.... | 10¼ | 10 | 10 | 9⅜ | 9⅝ | 9⅜ | 9⅜ | 9⅜ | 9⅝ | 9¼ | 9¼ | 9 |
| 1895.... | 10 | 9⅞ | 9⅞ | 9½ | 9½ | 9¼ | 9¾ | 9⅜ | 10⅝ | 9¾ | 10¾ | 10½ |
| 1896.... | 10⅛ | 9¾ | 11¼ | 10 | 11¼ | 10⅞ | 11 | 10¾ | 11½ | 10⅞ | 11¾ | 11⅜ |
| 1897.... | 12 | 11½ | 12 | 11 | 11⅞ | 11½ | 11½ | 11 | 11⅝ | 10¾ | 11⅝ | 10⅞ |
| 1898.... | 11 | 10 9/16 | 11¾ | 11⅞ | 12 | 11⅞ | 12⅛ | 11⅞ | 12⅜ | 12 | 11⅞ | 11⅝ |
| 1899.... | 17 | 13¼ | 18½ | 17 | 18 | 17¼ | 19⅜ | 18 | 19¼ | 18½ | 18¼ | 17⅜ |
| 1900.... | 16½ | 16¼ | 16½ | 16 | 17 | 16¼ | 17¼ | 17 | 17¼ | 16½ | 16½ | 16⅜ |
| 1901.... | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| 1902.... | 11 | 13 | 12½ | 13½ | 12¼ | 12½ | 12 | 12¼ | 12 | 12⅜ | 12¼ | 12⅜ |

## MONTHLY PRICES OF LAKE SUPERIOR INGOT COPPER, 1860-1902.

(*July–December.*)

| Year. | July. | | August. | | September. | | October. | | November. | | December. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. | Lowest. |
| 1860.... | 21¾ | 21½ | 21½ | 21½ | 22 | 21¼ | 22 | 21½ | 21½ | 20¼ | 20¼ | 19¾ |
| 1861.... | 18 | 17½ | 19 | 17¾ | 20¼ | 19 | 20½ | 20 | 22½ | 20¼ | 27 | 22½ |
| 1862.... | 24½ | 22½ | 24½ | 24 | 27 | 24¼ | 32⅞ | 27 | 32⅞ | 30½ | 31½ | 30½ |
| 1863.... | 32 | 29 | 31 | 29 | 32¼ | 31 | 34¼ | 32¼ | 38½ | 34½ | 38¾ | 38½ |
| 1864.... | 55 | 49 | 52½ | 50 | 52½ | 47½ | 48 | 47 | 49 | 47 | 50 | 48½ |
| 1865.... | 30¼ | 28 | 32 | 30½ | 32¾ | 31½ | 33 | 32½ | 45½ | 33 | 45½ | 39½ |
| 1866.... | 33½ | 31 | 31 | 30 | 31½ | 30¾ | 31 | 30¾ | 30¾ | 26½ | 29 | 26½ |
| 1867.... | 26 | 24 | 26¼ | 25¾ | 27¼ | 26¼ | 26¾ | 22¾ | 23 | 22¾ | 23 | 21½ |
| 1868.... | 24½ | 23⅜ | 24¼ | 24 | 24 | 23¾ | 24 | 23 | 24 | 22½ | 24½ | 23¾ |
| 1869.... | 22¼ | 21⅞ | 23⅜ | 21⅞ | 23 | 22 | 22¾ | 22 | 22½ | 22 | 22 | 21½ |
| 1870.... | 20½ | 20⅜ | 21⅜ | 20⅜ | 21½ | 20¾ | 21¾ | 21½ | 23⅜ | 21¾ | 22⅝ | 22¼ |
| 1871.... | 22¼ | 21⅝ | 23 | 22⅜ | 22⅞ | 22⅞ | 23⅞ | 23¼ | 24¼ | 23¼ | 27 | 24½ |
| 1872.... | 34 | 33 | 35 | 32½ | 35¼ | 33 | 34¾ | 31¼ | 32¼ | 30¾ | 32½ | 30¾ |
| 1873.... | 29 | 26⅝ | 27½ | 27 | 27 | 25½ | 25½ | 24 | 24 | 21 | 25 | 23 |
| 1874.... | 24¼ | 20 | 21 | 19 | 21½ | 21 | 22¼ | 21¼ | 23¾ | 22¼ | 23¼ | 23¼ |
| 1875.... | 23 | 22⅝ | 23⅜ | 23 | 23⅞ | 23⅛ | 23¼ | 23 | 23¼ | 23 | 23⅜ | 23⅜ |
| 1876.... | 20 | 19½ | 19½ | 18¾ | 21 | 18¾ | 21¼ | 20½ | 20½ | 20 | 20 | 19⅜ |
| 1877.... | 19¼ | 19 | 19 | 17⅞ | 18½ | 17⅞ | 18 | 17¾ | 17¾ | 17⅝ | 17¾ | 17½ |
| 1878.... | 16¼ | 16 | 16 | 16 | 16¼ | 16 | 16 | 15½ | 15⅞ | 15½ | 16 | 15⅞ |
| 1879.... | 16⅜ | 16 | 16⅜ | 16 | 17 | 16¼ | 21½ | 18 | 21¾ | 21 | 21½ | 21 |
| 1880.... | 18⅞ | 18½ | 19⅜ | 19 | 18⅞ | 18¾ | 18⅞ | 18¾ | 18⅞ | 18¾ | 19⅛ | 18⅞ |
| 1881.... | 16½ | 16 | 16⅜ | 16⅜ | 18⅜ | 16¾ | 18⅜ | 18 | 19 | 18⅛ | 20⅜ | 19⅜ |
| 1882.... | 18¼ | 18⅛ | 18¼ | 18⅛ | 18¼ | 18 | 18¼ | 18 | 18⅛ | 18 | 18 | 17⅞ |
| 1883.... | 15⅜ | 15 | 15 | 15 | 15¼ | 15⅛ | 15¼ | 15⅛ | 15 | 14⅞ | 15 | 14⅞ |
| 1884.... | 14⅜ | 13⅞ | 14 | 13⅞ | 13⅜ | 13 | 13⅜ | 12⅞ | 13 | 12½ | 12⅛ | 11 |
| 1885.... | 11¼ | 10⅞ | 11¼ | 11 | 11½ | 10$\frac{15}{16}$ | 11⅜ | 10⅝ | 11⅛ | 10⅝ | 11½ | 11$\frac{1}{16}$ |
| 1886.... | 10⅜ | 10 | 10¼ | 10 | 11⅛ | 10¼ | 11¾ | 11⅛ | 12 | 11¾ | 12⅜ | 11⅞ |
| 1887.... | 10¾ | 10⅛ | 10¾ | 10⅝ | 11 | 10⅝ | 12$\frac{3}{16}$ | 10$\frac{3}{16}$ | 14$\frac{15}{16}$ | 11$\frac{1}{16}$ | 17¾ | 14$\frac{15}{16}$ |
| 1888.... | 16$\frac{9}{16}$ | 16$\frac{15}{16}$ | 17 | 16⅝ | 17$\frac{7}{16}$ | 16$\frac{9}{16}$ | 17⅜ | 17$\frac{7}{16}$ | 17⅜ | 17¼ | 17$\frac{9}{16}$ | 17$\frac{1}{16}$ |
| 1889.... | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 13¼ | 11⅛ | 14½ | 14 |
| 1890.... | 17¼ | 16½ | 17¼ | 17 | 17 | 17 | 16⅞ | 16¾ | 16¾ | 16¾ | 16 | 15 |
| 1891.... | 12⅞ | 12½ | 12⅝ | 12 | 12½ | 12⅛ | 12⅝ | 11⅝ | 11½ | 11 | 11¼ | 10¼ |
| 1892.... | 11¾ | 11¼ | 11¾ | 11⅝ | 11⅝ | 11$\frac{1}{16}$ | 11¾ | 11$\frac{1}{16}$ | 12 | 11¾ | 12⅜ | 12¼ |
| 1893.... | 10½ | 10¼ | 10⅛ | 9⅝ | 9⅞ | 9¾ | 9¾ | 9¾ | 10¼ | 9¾ | 10½ | 10¾ |
| 1894.... | 9⅜ | 9 | 9⅜ | 9 | 9⅞ | 9⅛ | 9¾ | 9½ | 9½ | 9⅜ | 10 | 9½ |
| 1895.... | 11¾ | 10½ | 12¼ | 11¾ | 12¼ | 12 | 12 | 11¾ | 11⅝ | 11 | 11 | 10 |
| 1896 ... | 11¾ | 11 | 11⅛ | 10⅞ | 10⅞ | 10⅜ | 10⅞ | 10½ | 11½ | 10⅞ | 11½ | 11¼ |
| 1897.... | 11⅜ | 11 | 11¼ | 11 | 11⅜ | 11¼ | 11¼ | 11 | 11 | 10¾ | 11 | 10⅞ |
| 1898.... | 11¾ | 11½ | 12⅛ | 11⅜ | 12¼ | 12⅛ | 11½ | 12¼ | 11¾ | 12½ | 12⅞ | 12⅝ |
| 1899.... | 18½ | 18¼ | 18¾ | 18½ | 18½ | 18¾ | 18½ | 17 | 17¼ | 17 | 17 | 16¼ |
| 1900.... | 16½ | 16⅜ | 16¼ | 16½ | 16⅞ | 16¼ | 16⅞ | 16⅜ | 17 | 16¾ | 17 | 16¾ |
| 1901.... | 17 | 16¾ | 16¾ | 16¾ | 16¾ | 16¼ | 16$\frac{15}{16}$ | 16¾ | 16$\frac{15}{16}$ | 16$\frac{15}{16}$ | 17 | 13 |
| 1902.... | 12 | 12½ | 11⅝ | 12½ | 11¾ | 12¼ | 11¾ | 12¼ | 11½ | 12 | 11⅝ | 12 |

## AVERAGE HIGHEST AND LOWEST PRICES OF LAKE COPPER.

1860–1902.
(*Cents.*)

| Year. | Average Price. | Lowest Price. | | Highest Price. | |
|---|---|---|---|---|---|
| 1860 | 22⅞ | 19¾ | Dec. | 24 | Jan. |
| 1861 | 22¼ | 17½ | July | 27 | Dec. |
| 1862 | 21⅞ | 20¾ | May | 32⅞ | Nov. |
| 1863 | 33⅞ | 29 | July | 38¾ | Dec. |
| 1864 | 47 | 39 | Jan. | 55 | July |
| 1865 | 39¼ | 28 | July | 50½ | Jan. |
| 1866 | 34¼ | 26½ | Nov. | 42 | Jan. |
| 1867 | 25⅜ | 21½ | Dec. | 29¼ | Jan. |
| 1868 | 23 | 21½ | Jan. | 24½ | Dec. |
| 1869 | 24¼ | 21½ | Dec. | 27 | Feb. |
| 1870 | 21$\frac{3}{16}$ | 19 | Mch. | 23⅜ | Nov. |
| 1871 | 24⅛ | 21¼ | Apr. | 27 | Dec. |
| 1872 | 35$\frac{9}{16}$ | 27⅛ | Jan. | 44 | Apr. |
| 1873 | 28 | 21 | Nov. | 35 | Jan. |
| 1874 | 22 | 19 | Aug. | 25 | Jan. |
| 1875 | 22$\frac{11}{16}$ | 21½ | Jan. | 23⅞ | Sep. |
| 1876 | 21 | 18¾ | Aug. | 23¼ | Jan. |
| 1877 | 19 | 17½ | Dec. | 20½ | Feb. |
| 1878 | 16$\frac{9}{16}$ | 15½ | Oct. | 17⅝ | Jan. |
| 1879 | 18⅝ | 15½ | Jan. | 21¾ | Nov. |
| 1880 | 21$\frac{7}{16}$ | 17⅞ | June | 25 | Jan. |
| 1881 | 18$\frac{3}{16}$ | 16 | July | 20⅜ | Dec. |
| 1882 | 19⅛ | 17⅞ | Apr. | 20⅜ | Jan. |
| 1883 | 16½ | 14⅞ | Nov. | 18⅛ | Jan. |
| 1884 | 13 | 11 | Dec. | 15 | Dec. |
| 1885 | 10.67 | 9.8 | May | 11⅞ | Feb. |
| 1886 | 11$\frac{1}{16}$ | 10 | May | 12⅛ | Dec. |
| 1887 | 13.85 | 9.95 | May | 17¾ | Dec. |
| 1888 | 16.78 | 15.85 | Jan. | 17.60 | Nov. |
| 1889 | 13.49 | 11 | Sep. | 17½ | Jan. |
| 1890 | 15.60 | 14 | Mch. | 17¼ | July |
| 1891 | 12.76 | 10¼ | Dec. | 15 | Jan. |
| 1892 | 11.56 | 10½ | Feb. | 12⅜ | Dec. |
| 1893 | 10.75 | 9.6 | Aug. | 12½ | Jan. |
| 1894 | 9.52 | 9 | June | 10¼ | Jan. |
| 1895 | 10.73 | 9⅜ | Apr. | 12¼ | Aug. |
| 1896 | 10.98 | 9¾ | Jan. | 12 | June |
| 1897 | 11.36 | 10¾ | Nov. | 12 | Jan. |
| 1898 | 12.05 | 11 | Jan. | 13¼ | Dec. |
| 1899 | 17.76 | 13¼ | Jan. | 19⅜ | Apr. |
| 1900 | 16.65 | 16 | Feb. | 17¼ | Apr. |
| 1901 | 16.72 | 13 | Dec. | 17 | Jan. |
| 1902 | 12.16 | 11 | Jan. | 13½ | Feb. |

## AVERAGE AMERICAN AND ENGLISH PRICES.

### 1880–1902.

The following table of average annual prices of copper in England and the United States is based upon the New York price for Lake copper and the London price for Standard copper. The last two columns give the American prices in cents and fractions and the English equivalent in sterling. English prices are for long tons of 2,240 pounds, and American prices for pounds avoirdupois, the last column, giving English equivalent of the American prices, being figured in long tons.

| Year. | English Prices. | | | | | | | | | | | | American Prices. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lowest. | | | Highest. | | | Fluctuation. | | | Average. | | | Average Cents. | Average. | | |
| | £ | s. | d. | £ | s. | d. | £ | s. | d. | £ | s. | d. | | £ | s. | d. |
| 1880.... | 54 | 10 | 0 | 74 | 0 | 0 | 10 | 10 | 0 | 62 | 14 | 7 | 21 7/16 | 99 | 0 | 8 |
| 1881.... | 57 | 0 | 0 | 72 | 10 | 0 | 15 | 10 | 0 | 61 | 16 | 9 | 18 3/16 | 84 | 0 | 8 |
| 1882.... | 63 | 0 | 0 | 71 | 10 | 0 | 8 | 10 | 0 | 66 | 10 | 5 | 19 1/8 | 88 | 6 | 11 |
| 1883.... | 57 | 0 | 0 | 67 | 10 | 0 | 9 | 10 | 0 | 62 | 17 | 11 | 16 1/2 | 76 | 3 | 7 |
| 1884.... | 47 | 5 | 0 | 58 | 0 | 0 | 10 | 15 | 0 | 53 | 17 | 6 | 13 | 59 | 19 | 0 |
| 1885.... | 38 | 10 | 0 | 61 | 12 | 6 | 23 | 2 | 6 | 43 | 11 | 0 | 10.67 | 49 | 6 | 5 |
| 1886.... | 38 | 10 | 0 | 43 | 15 | 0 | 5 | 5 | 0 | 40 | 1 | 8 | 11 1/16 | 51 | 1 | 10 |
| 1887.... | 38 | 7 | 6 | 85 | 5 | 0 | 46 | 17 | 6 | 46 | 0 | 6 | 13.85 | 64 | 0 | 0 |
| 1888.... | 73 | 0 | 0 | 105 | 0 | 0 | 32 | 0 | 0 | 81 | 11 | 3 | 16.78 | 77 | 10 | 1 |
| 1889.... | 35 | 0 | 0 | 80 | 0 | 0 | 45 | 0 | 0 | 49 | 14 | 8 | 13.49 | 62 | 6 | 5 |
| 1890.... | 46 | 10 | 0 | 61 | 12 | 6 | 15 | 2 | 6 | 54 | 5 | 3 | 15.60 | 72 | 1 | 10 |
| 1891.... | 44 | 1 | 3 | 56 | 10 | 0 | 12 | 8 | 9 | 51 | 9 | 4 | 12.76 | 58 | 19 | 1 |
| 1892.... | 43 | 10 | 0 | 47 | 18 | 9 | 4 | 8 | 9 | 45 | 13 | 2 | 11.56 | 53 | 8 | 4 |
| 1893.... | 40 | 12 | 6 | 46 | 16 | 3 | 6 | 3 | 9 | 43 | 15 | 6 | 10.75 | 49 | 13 | 10 |
| 1894.... | 37 | 17 | 6 | 43 | 0 | 0 | 5 | 2 | 6 | 40 | 7 | 4 | 9.52 | 44 | 0 | 0 |
| 1895.... | 38 | 13 | 9 | 47 | 8 | 9 | 8 | 15 | 0 | 42 | 19 | 7 | 10.73 | 49 | 12 | 0 |
| 1896.... | 40 | 10 | 0 | 50 | 8 | 9 | 9 | 18 | 9 | 46 | 18 | 1 | 10.98 | 50 | 14 | 9 |
| 1897.... | 47 | 0 | 0 | 51 | 15 | 0 | 4 | 15 | 0 | 49 | 2 | 6 | 11.36 | 52 | 10 | 2 |
| 1898.... | 49 | 5 | 0 | 57 | 8 | 9 | 8 | 3 | 9 | 51 | 16 | 7 | 12.05 | 55 | 13 | 10 |
| 1899.... | 58 | 1 | 3 | 79 | 2 | 6 | 21 | 1 | 3 | 73 | 13 | 9 | 17.76 | 82 | 0 | 11 |
| 1900.... | 70 | 14 | 2 | 78 | 7 | 1 | 7 | 12 | 11 | 73 | 12 | 6 | 16.65 | 76 | 18 | 2 |
| 1901.... | 47 | 0 | 0 | 72 | 17 | 6 | 25 | 17 | 6 | 66 | 19 | 8 | 16.72 | 77 | 4 | 7 |
| 1902.... | 47 | 10 | 0 | 56 | 15 | 0 | 9 | 5 | 0 | 52 | 11 | 5 | 12.16 | 56 | 3 | 8 |

## TABLE FOR REDUCING ENGLISH INTO AMERICAN PRICES.

The following table shows the corresponding value in cents and fractions, per pound, of copper quoted at various prices from £35—the lowest quotation ever made—to £99 per long ton, exchange being figured on the basis of $4.85 as equal to one pound sterling:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| £36.... | 7.79c. | £52.... | 11.25c. | £68.... | 14.72c. | £84.... | 18.18c. |
| £37.... | 8.01c. | £53.... | 11.47c. | £69.... | 14.93c. | £85.... | 18.40c. |
| £38.... | 8.22c. | £54.... | 11.69c. | £70.... | 15.15c. | £86.... | 18.62c. |
| £39.... | 8.44c. | £55.... | 11.90c. | £71.... | 15.37c. | £87.... | 18.83c. |
| £40.... | 8.66c. | £56.... | 12.12c. | £72.... | 15.58c. | £88.... | 19.05c. |
| £41.... | 8.87c. | £57.... | 12.34c. | £73.... | 15.80c. | £89.... | 19.27c. |
| £42.... | 9.09c. | £58.... | 12.55c. | £74.... | 16.02c. | £90.... | 19.48c. |
| £43.... | 9.31c. | £59.... | 12.77c. | £75.... | 16.23c. | £91.... | 19.70c. |
| £44.... | 9.52c. | £60.... | 12.99c. | £76.... | 16.45c. | £92.... | 19.92c. |
| £45.... | 9.74c. | £61.... | 13.20c. | £77.... | 16.67c. | £93.... | 20.13c. |
| £46.... | 9.95c. | £62.... | 13.42c. | £78.... | 16.88c. | £94.... | 20.35c. |
| £47.... | 10.17c. | £63.... | 13.64c. | £79.... | 17.10c. | £95.... | 20.56c. |
| £48.... | 10.39c. | £64.... | 13.85c. | £80.... | 17.32c. | £96.... | 20.78c. |
| £49.... | 10.60c. | £65.... | 14.07c. | £81.... | 17.53c. | £97.... | 21.00c. |
| £50.... | 10.82c. | £66.... | 14.29c. | £82.... | 17.75c. | £98.... | 21.21c. |
| £51.... | 11.04c. | £67.... | 14.50c. | £83.... | 17.97c. | £99.... | 21.43c. |

## PROPORTION OF COPPER TO TOTAL VALUE AMERICAN METAL PRODUCTION.

### 1888–1901.

| Year. | Total Value Metallic Products. | Total Value of Copper Production. | Production of Copper in Pounds. | Percentage Copper Values. |
|---|---|---|---|---|
| 1888 | $253,731,822 | $ 33,833,954 | 231,270,622 | 13.3 |
| 1889 | 267,247,033 | 26,907,809 | 231,246,214 | 10.0 |
| 1890 | 305,735,670 | 30,848,797 | 265,115,133 | 10.1 |
| 1891 | 300,232,798 | 38,455,300 | 295,812,076 | 12.1 |
| 1892 | 307,936,189 | 37,977,142 | 352,971,744 | 12.3 |
| 1893 | 250,207,406 | 32,054,601 | 339,785,972 | 12.8 |
| 1894 | 218,382,494 | 33,141,142 | 364,866,808 | 15.2 |
| 1895 | 282,149,808 | 38,682,347 | 392,639,964 | 13.8 |
| 1896 | 287,860,155 | 49,456,603 | 460,061,430 | 17.2 |
| 1897 | 302,531,147 | 54,080,180 | 494,078,274 | 17.9 |
| 1898 | 343,748,268 | 61,865,276 | 526,375,591 | 18.0 |
| 1899 | 525,797,557 | 101,222,712 | 581,319,091 | 19.0 |
| 1900 | 550,425,286 | 98,494,039 | 602,808,839 | 17.9 |
| 1901 | 524,873,284 | 86,629,266 | 601,499,886 | 16.5 |

## LAKE SUPERIOR MINE DIVIDENDS.

### TOTALS BY MINES, 1849–1902.

| Company. | Condition. | First. | Last. | Total | Amount. |
|---|---|---|---|---|---|
| Atlantic | *a* | 1878 | 1901 | 18 | $ 940,000 |
| Cliff | *b* | 1849 | 1867 | 37 | 2,518,620 |
| Central | *b* | 1864 | 1891 | 30 | 1,970,000 |
| Copper Falls | *b* | 1864 | 1871 | 3 | 100,000 |
| Calumet | *c* | 1870 | 1871 | 3 | 300,000 |
| Calumet & Hecla | *a* | 1871 | 1902 | 120 | 78,900,000 |
| Franklin | *a* | 1863 | 1894 | 21 | 1,240,000 |
| Hecla | *c* | 1869 | 1871 | 7 | 650,000 |
| Kearsarge | *d* | 1890 | 1897 | 3 | 160,000 |
| Minnesota | *e* | 1854 | 1876 | 19 | 1,820,000 |
| National | *b* | 1861 | 1872 | 9 | 320,000 |
| Osceola | *a* | 1878 | 1901 | 52 | 4,247,300 |
| Pewabic | *f* | 1862 | 1873 | 11 | 1,000,000 |
| Phoenix | *a* | 1877 | 1877 | 1 | 20,000 |
| Quincy | *a* | 1862 | 1902 | 73 | 13,920,000 |
| Ridge | *g* | 1873 | 1880 | 4 | 100,000 |
| Tamarack | *a* | 1888 | 1901 | 37 | 8,490,000 |
| Wolverine | *a* | 1898 | 1902 | 9 | 990,000 |
| Totals | | | | 457 | 117,685,920 |

---

*a*. *Active.*

*b*. *Idle.*

*c*. *Absorbed by Calumet & Hecla.*

*d*. *Absorbed by Osceola.*

*e*. *Absorbed by Michigan.*

*f*. *Absorbed by Quincy.*

*g*. *Absorbed by Mass.*

## PRICES AND SALES OF AMERICAN COPPER SHARES.

### 1901-1902.

| Company. | 1901. | | | 1902. | | |
|---|---|---|---|---|---|---|
| | Highest. | Lowest. | Sales. | Highest. | Lowest. | Sales. |
| Adventure | $ 32.50 | $ 9.25 | 209,303 | $ 24.75 | $ 12.50 | 59,995 |
| Allouez | 6.25 | 2.50 | 71,338 | 4.75 | 2.25 | 24,990 |
| Amalgamated | 129.00 | 60.00 | 1,597,129 | 78.87 | 53.13 | 758,757 |
| Anaconda | 53.00 | 29.00 | 32,147 | 36.00 | 21.00 | 9,891 |
| Arcadian | 24.75 | 3.00 | 98,157 | 13.25 | 3.50 | 116,613 |
| Arnold | 5.75 | .50 | 26,911 | 1.00 | .50 | 4,070 |
| Ashbed | ..... | ..... | ...... | .22 | .20 | 150 |
| Atlantic | 41.50 | 24.38 | 65,564 | 21.00 | 36.00 | 24,119 |
| Baltic | 58.00 | 31.00 | 160,486 | 63.00 | 34.00 | 47,084 |
| Bingham | 43.75 | 15.00 | 213,894 | 39.75 | 20.50 | 99,650 |
| British Columbia | 23.25 | 9.00 | 30,268 | 10.50 | 5.00 | 8,425 |
| Calumet & Hecla | 860.00 | 550.00 | 5,653 | 650.00 | 420.00 | 4,357 |
| Centennial | 34.25 | 10.50 | 244,408 | 27.75 | 11.00 | 260,487 |
| Copper Range | 83.00 | 34.00 | 278,772 | 65.25 | 43.50 | 539,165 |
| Elm River | 7.00 | 1.75 | 63,421 | 5.50 | 1.50 | 87,317 |
| Franklin | 25.13 | 11.00 | 96,751 | 16.00 | 7.50 | 18,344 |
| Isle Royale | 56.50 | 18.50 | 245,972 | 25.00 | 9.00 | 43,083 |
| Mass | 37.63 | 11.00 | 323,873 | 21.50 | 12.50 | 112,645 |
| Mayflower | 5.63 | 1.50 | 93,174 | 3.63 | 1.50 | 28,719 |
| Michigan | 19.75 | 7.00 | 139,692 | 13.25 | 7.00 | 38,645 |
| Mohawk | 56.25 | 22.00 | 139,692 | 49.00 | 27.00 | 120,238 |
| Montreal & Boston | ..... | ..... | ...... | 4.75 | 2.00 | 342,584 |
| National | 5.25 | .50 | 20,280 | 3.75 | 1.00 | 2,800 |
| Old Colony | 7.00 | 2.50 | 65,491 | 4.50 | .85 | 17,101 |
| Old Dominion | 38.75 | 21.00 | 275,689 | 30.00 | 14.25 | 68,864 |
| Osceola | 120.00 | 72.00 | 168,790 | 89.75 | 47.50 | 98,979 |
| Parrot | 58.50 | 26.50 | 160,874 | 35.00 | 21.00 | 26,392 |
| Phœnix | 8.75 | 3.50 | 48,074 | 5.00 | 3.25 | 16,820 |
| Quincy | 187.00 | 125.00 | 13,718 | 147.00 | 100.00 | 5,119 |
| Rhode Island | 10.00 | 3.00 | 99,768 | 3.25 | 1.25 | 20,318 |
| Santa Fe | 10.25 | 2.50 | 109,661 | 4.00 | 1.00 | 69,484 |
| Shannon | ..... | ..... | ...... | 13.50 | 8.00 | 33,486 |
| Tamarack | 360.00 | 230.00 | 11,924 | 281.00 | 140.00 | 14,396 |
| Tecumseh | 3.00 | .50 | 78,076 | 3.50 | .50 | 7,292 |
| Tennessee | 23.00 | 17.00 | 1,952 | 18.50 | 10.75 | 1,984 |
| Trimountain | 57.00 | 19.75 | 231,320 | 125.00 | 31.50 | 71,455 |
| Trinity | 41.00 | 10.00 | ...... | 18.50 | 8.00 | 68,719 |
| United | ..... | ..... | ...... | 35.00 | 19.00 | 10,214 |
| Utah | 39.00 | 18.63 | 228,600 | 27.25 | 14.00 | 106,193 |
| Victoria | 12.00 | 3.38 | 207,651 | 6.75 | 3.00 | 54,642 |
| Washington | .80 | .13 | 5,530 | 1.50 | .25 | 975 |
| Winona | 10.00 | 2.00 | 109,433 | 6.00 | 1.00 | 57,987 |
| Wolverine | 74.00 | 44.00 | 99,765 | 61.00 | 42.00 | 24,197 |
| Wyandot | 3.00 | 1.00 | 35,378 | 1.75 | .75 | 15,342 |

## DIVIDENDS OF AMERICAN COPPER MINES.

| Company. | 1901. | 1902. | Total. |
|---|---|---|---|
| Aberdeen | $ 32,175 | $ ....... | $ 32,175 |
| Anaconda | 3,900,000 | 1,200,000 | 22,050,000 |
| Arizona | 866,000 | 1,115,000 | 3,445,468 |
| Atlantic | 80,000 | ........ | 940,000 |
| Boston & Montana | 5,250,000 | 900,000 | 27,125,000 |
| Butte & Boston | 600,000 | ........ | 1,600,000 |
| Calumet & Hecla | 4,500,000 | 2,500,000 | 79,850,000 |
| Carisa | 30,000 | ........ | 30,000 |
| Central | ........ | ........ | 1,970,000 |
| Cliff | ........ | ........ | 2,518,620 |
| Copper Falls | ........ | ........ | 100,000 |
| Dalton & Lark | 263,000 | ........ | 350,000 |
| Daly-West | 600,000 | 864,000 | 2,259,000 |
| Ducktown | 81,000 | ........ | 240,500 |
| Ferris-Haggarty | 10,000 | ........ | 15,000 |
| Franklin | ........ | ........ | 1,240,000 |
| Grand Gulch | ........ | ........ | 9,600 |
| Greene Cons. | 220,000 | ........ | 220,000 |
| Mammoth | 100,000 | ........ | 1,860,000 |
| Minnesota | ........ | ........ | 1,820,000 |
| Montana O. P. Co | 722,000 | 324,000 | 2,646,000 |
| Mountain | 720,000 | 300,000 | 3,393,750 |
| National | ........ | ........ | 320,000 |
| Osceola | 575,000 | ........ | 4,247,300 |
| Parrot | 1,264,000 | 115,000 | 5,772,925 |
| Pewabic | ........ | ........ | 1,000,000 |
| Phœnix | ........ | ........ | 20,000 |
| Pride of The West | ........ | 15,000 | 15,000 |
| Quincy (Mich.) | 900,000 | 700,000 | 13,920,000 |
| Quincy (Utah) | 725,000 | 234,000 | 959,375 |
| Ridge | ........ | ........ | 100,000 |
| Tamarack | 1,200,000 | ........ | 8,490,000 |
| United Verde | 2,700,000 | 1,800,000 | 23,398,680 |
| Utah | 732,000 | ........ | 732,000 |
| Wolverine | 240,000 | 240,000 | 990,000 |
| Totals | 26,310,175 | 10,307,000 | 212,080,393 |

## DIVIDENDS OF LAKE SUPERIOR MINES.

1849–1902.

| | 1849. | 1850. | 1851. | 1852. |
|---|---|---|---|---|
| Cliff .............. | $ 60,000 | $ 84,000 | $ 60,000 | $ 60,000 |
| Totals......... | $ 60,000 | $ 84,000 | $ 60,000 | $ 60,000 |

| | 1853. | 1854. | 1855. | 1856. |
|---|---|---|---|---|
| Cliff .............. | $ 90,000 | $ 108,000 | $ 78,000 | $ 180,000 |
| Minnesota......... | ......... | 90,000 | 90,000 | 200,000 |
| Totals......... | $ 90,000 | $ 198,000 | $ 168,000 | $ 380,000 |

| | 1857. | 1858. | 1859. | 1860. |
|---|---|---|---|---|
| Cliff .............. | $ 180,000 | $ 160,000 | $ 180,000 | $ ....... |
| Minnesota......... | 300,000 | 300,000 | 180,000 | 120,000 |
| Totals......... | $ 480,000 | $ 460,000 | $ 360,000 | $ 120,000 |

| | 1861. | 1862. | 1863. | 1864. |
|---|---|---|---|---|
| Cliff .............. | $ 80,000 | $ 80,000 | $ 180,000 | $ 320,000 |
| Minnesota.......... | 100,000 | 160,000 | 160,000 | 60,000 |
| National .......... | 80,000 | 80,000 | ......... | 80,000 |
| Pewabic........... | ......... | 60,000 | 120,000 | 200,000 |
| Quincy ........... | ......... | 60,000 | 200,000 | 280,000 |
| Franklin.......... | ......... | ......... | 60,000 | 100,000 |
| Central .......... | ......... | ......... | ......... | 50,000 |
| Copper Falls...... | ......... | ......... | ......... | 60,000 |
| Totals......... | $ 260,000 | $ 440,000 | $ 720,000 | $1,150,000 |

| | 1865. | 1866. | 1867. | 1868. |
|---|---|---|---|---|
| Cliff .............. | $ 200,000 | $ 120,000 | $ 60,000 | $ ....... |
| National .......... | 40,000 | ........ | ........ | ........ |
| Quincy............ | 160,000 | ........ | ........ | 60,000 |
| Franklin .......... | 60,000 | ........ | ........ | ........ |
| Central............ | 50,000 | 50,000 | 50,000 | 40,000 |
| Totals......... | $ 510,000 | $ 170.000 | $ 110,000 | $ 100,000 |

| | 1869. | 1870. | 1871. | 1872. |
|---|---|---|---|---|
| Cliff .............. | $ ....... | $ ....... | $ 100,000 | $ 100,000 |
| Minnesota.......... | ........ | ........ | ........ | 50,000 |
| National .......... | ........ | ........ | 20,000 | 20,000 |
| Pewabic........... | ........ | ........ | 20,000 | 40,000 |
| Quincy ........... | 40,000 | 120,000 | 140,000 | 350,000 |
| Franklin .......... | ........ | ........ | 20,000 | 40,000 |
| Central ........... | 70,000 | 80,000 | 50,000 | 80,000 |
| Copper Falls....... | ........ | ........ | 40,000 | ........ |
| Hecla ............. | 100,000 | 300,000 | 250,000 | ........ |
| Calumet .......... | ........ | 200,000 | 100,000 | ........ |
| Calumet & Hecla ... | ........ | ........ | 900,000 | 2,400,000 |
| Totals ........ | $ 210,000 | $ 700.000 | $1,640,000 | $3,080,000 |

## DIVIDENDS OF LAKE SUPERIOR MINES. (Continued.)

1849-1902.

| | 1873. | 1874. | 1875. | 1876. |
|---|---|---|---|---|
| Minnesota.......... | $ ....... | $ ....... | $ ....... | $ 10,000 |
| Pewabic........... | 20,000 | ........ | ........ | ........ |
| Quincy........... | 100,000 | 160,000 | 220,000 | 160,000 |
| Central........... | 160,000 | 160,000 | 80,000 | 100,000 |
| Calumet & Hecla... | 2,000,000 | 1,600,000 | 1,600,000 | 1,600,000 |
| Ridge............. | 50,000 | 20,000 | 20,000 | ........ |
| Totals........ | $2,330,000 | $1,940,000 | $1,920,000 | $1,870,000 |

| | 1877. | 1878. | 1879. | 1880. |
|---|---|---|---|---|
| Cliff.............. | $ ....... | $ ....... | $ 38,620 | $ ....... |
| Quincy........... | 80,000 | 100,000 | 40,000 | 220,000 |
| Central........... | 140,000 | 100,000 | 80,000 | 100,000 |
| Calumet & Hecla... | 1,600,000 | 1,600,000 | 1,600,000 | 2,500,000 |
| Ridge............. | ........ | ........ | ........ | 10,000 |
| Phœnix........... | 20,000 | ........ | ........ | ........ |
| Atlantic........... | ........ | 20,000 | ........ | 40,000 |
| Osceola........... | ........ | 40,000 | 60,000 | 210,000 |
| Totals........ | $1,840,000 | $1,860,000 | $1,818,620 | $3,080,000 |

| | 1881. | 1882. | 1883. | 1884. |
|---|---|---|---|---|
| Quincy........... | $ 320,000 | $ 520,000 | $ 380,000 | $ 280,000 |
| Franklin.......... | ........ | ........ | ........ | 80,000 |
| Central........... | 120,000 | 50,000 | 60,000 | 40,000 |
| Calumet & Hecla... | 2,000,000 | 2,000,000 | 2,000,000 | 800,000 |
| Atlantic........... | ........ | 80,000 | 80,000 | 40,000 |
| Osceola........... | 225,000 | 200,000 | 150,000 | 87,500 |
| Totals........ | $2,665,000 | $2,850,000 | $2,670,000 | $1,327,500 |

| | 1885. | 1886. | 1887. | 1888. |
|---|---|---|---|---|
| Quincy........... | $ 180,000 | $ 240,000 | $ 200,000 | $ 360,000 |
| Franklin.......... | 40,000 | 80,000 | 40,000 | 120,000 |
| Central........... | 30,000 | 40,000 | 40,000 | 70,000 |
| Calumet & Hecla... | 1,700,000 | 1,500,000 | 1,000,000 | 2,000,000 |
| Atlantic........... | 20,000 | 40,000 | 40,000 | 120,000 |
| Osceola........... | ........ | ........ | 50,000 | 150,000 |
| Tamarack......... | ........ | ........ | ........ | 440,000 |
| Totals........ | $1,970,000 | $1,900,000 | $1,370,000 | $3,260,000 |

**DIVIDENDS OF LAKE SUPERIOR MINES. (Continued.)**

1849–1902.

| | 1889. | 1890. | 1891. | 1892. |
|---|---|---|---|---|
| Quincy | $ 280,000 | $ 320,000 | $ 450,000 | $ 350,000 |
| Franklin | 80,000 | 80,000 | 80,000 | 160,000 |
| Central | 40,000 | 20,000 | 20,000 | ........ |
| Calumet & Hecla | 1,500,000 | 2,000,000 | 2,000,000 | 2,000,000 |
| Atlantic | 80,000 | 100,000 | 40,000 | ........ |
| Osceola | 50,000 | 225,000 | 150,000 | 150,000 |
| Tamarack | 640,000 | 590,000 | 800,000 | 600,000 |
| Kearsarge | ........ | 80,000 | ........ | ........ |
| Totals | $2,670,000 | $3,415,000 | $3,540,000 | $3,260,000 |

| | 1893. | 1894. | 1895. | 1896. |
|---|---|---|---|---|
| Pewabic | $ 400,000 | $ ....... | $ 140,000 | $ ....... |
| Quincy | 300,000 | 400,000 | 600,000 | 1,000,000 |
| Franklin | 120,000 | 80,000 | ........ | ........ |
| Calumet & Hecla | 2,000,000 | 1,500,000 | 2,000,000 | 2,500,000 |
| Osceola | 100,000 | ........ | 100,000 | 125,000 |
| Tamarack | 600,000 | 400,000 | 400,000 | 360,000 |
| Kearsarge | ........ | ........ | 40,000 | ........ |
| Totals | $3,520,000 | $2,380,000 | $3,280,000 | $3,985,000 |

| | 1897. | 1898. | 1899. | 1900. |
|---|---|---|---|---|
| Quincy | $ 800,000 | $1,000,000 | $ 950,000 | $ 900,000 |
| Calumet & Hecla | 4,000,000 | 5,000,000 | 10,000,000 | 7,000,000 |
| Atlantic | 40,000 | 40,000 | ........ | 80,000 |
| Osceola | 191,000 | 277,250 | 558,450 | 571,200 |
| Tamarack | 360,000 | 480,000 | 600,000 | 1,020,000 |
| Kearsarge | 40,000 | ........ | ........ | ........ |
| Wolverine | ........ | 60,000 | 210,000 | 240,000 |
| Totals | $5,431,000 | $6,857,250 | $12,318,450 | $9,811,200 |

| | 1901. | 1902. |
|---|---|---|
| Quincy | $ 900,000 | $ 700,000 |
| Calumet & Hecla | 4,500,000 | 2,500,000 |
| Atlantic | 80,000 | ........ |
| Osceola | 576,000 | ........ |
| Tamarack | 1,200,000 | ........ |
| Wolverine | 240,000 | 240,000 |
| Totals | $7,496,900 | $3,440,000 |

## DIVIDENDS AND ASSESSMENTS OF LAKE SUPERIOR MINES.

| Name of Company. | Assessments. | Dividends. | Credit Balance. | Debit Balance. |
|---|---|---|---|---|
| Adventure Cons | $1,600,000 | $......... | $......... | $1,600,000 |
| Albany & Boston | 840,000 | ......... | ......... | 840,000 |
| Allouez | 1,916,000 | ......... | ......... | 1,916,000 |
| Atlantic | 980,000 | 940,000 | ......... | 40,000 |
| Arcadian | 1,800,000 | ......... | ......... | 1,800,000 |
| Arnold | 810,000 | ......... | ......... | 810,000 |
| Aztec | 150,000 | ......... | ......... | 150,000 |
| Baltic | 800,000 | ......... | ......... | 800,000 |
| Belt | 1,300,000 | ......... | ......... | 1,300,000 |
| Bohemian | 180,000 | ......... | ......... | 180,000 |
| Caledonia | 140,000 | ......... | ......... | 140,000 |
| Calumet & Hecla | 1,200,000 | 79,850,000 | 78,650,000 | ........ |
| Centennial | 2,285,000 | ......... | ......... | 2,285,000 |
| Central | 100,000 | 1,970,000 | 1,870,000 | ........ |
| Cliff | 111,000 | 2,518,620 | 2,407,620 | ........ |
| Conglomerate | 1,300,000 | ......... | ......... | 1,300,000 |
| Copper Falls | 1,000,000 | 100,000 | ......... | 900,000 |
| Copper Range Co. | 1,250,000 | ......... | ......... | 1,250,000 |
| Delaware | 2,000,000 | ......... | ......... | 2,000,000 |
| Elm River | 800,000 | ......... | ......... | 800,000 |
| Evergreen Bluff | 225,000 | ......... | ......... | 225,000 |
| Flint Steel | 264,000 | ......... | ......... | 264,000 |
| Forest | 180,000 | ......... | ......... | 180,000 |
| Franklin | 220,000 | 1,240,000 | 1,020,000 | ........ |
| Humboldt | 120,000 | ......... | ......... | 120,000 |
| Huron | 240,000 | ......... | ......... | 240,000 |
| Indiana | 200,000 | ......... | ......... | 200,000 |
| Isle Royale Cons | 2,000,000 | ......... | ......... | 2,000,000 |
| Kearsarge | 180,000 | 160,000 | ......... | 20,000 |
| Mass Cons | 1,600,000 | ......... | ......... | 1,600,000 |
| Mayflower | 800,000 | ......... | ......... | 800,000 |
| Michigan | 1,300,000 | ......... | ......... | 1,300,000 |
| Miners' | 1,000,000 | ......... | ......... | 1,000,000 |
| Mohawk | 1,900,000 | ......... | ......... | 1,900,000 |
| Minnesota | 456,000 | 1,820,000 | 1,364,000 | ........ |
| National | 320,000 | 320,000 | ......... | ........ |
| Nonesuch | 400,000 | ......... | ......... | 400,000 |
| Northwest | 283,000 | ......... | ......... | 283,000 |
| Norwich | 230,000 | ......... | ......... | 230,000 |
| Ohio Trap Rock | 150,000 | ......... | ......... | 150,000 |
| Old Colony | 800,000 | ......... | ......... | 800,000 |
| Osceola | 1,700,000 | 4,247,300 | 2,207,300 | ........ |
| Pennsylvania | 126,000 | ......... | ......... | 126,000 |
| Peninsula | 400,000 | ......... | ......... | 400,000 |
| Pewabic | 585,200 | 1,000,000 | 414,800 | ........ |
| Phœnix | 1,037,500 | 20,000 | ......... | 1,017,500 |
| Phœnix Cons | 800,000 | ......... | ......... | 800,000 |
| Quincy | 200,000 | 13,920,000 | 13,720,000 | ........ |
| Ridge | 470,000 | 100,000 | ......... | 370,000 |
| Rhode Island | 600,000 | ......... | ......... | 600,000 |
| Tamarack | 320,000 | 8,490,000 | 8,170,000 | ........ |
| Tamarack Junior | 640,000 | ......... | ......... | 640,000 |
| Tecumseh | 500,000 | ......... | ......... | 500,000 |

## DIVIDENDS AND ASSESSMENTS OF LAKE SUPERIOR MINES. (Cont'd.)

| Name of Company. | Assessments. | Dividends. | Credit Balance. | Debit Balance. |
|---|---|---|---|---|
| Trimountain | 1,900,000 | ......... | ......... | 1,900,000 |
| Toltec Cons | 500,000 | ......... | ......... | 500,000 |
| Victoria | 1,000,000 | ......... | ......... | 1,000,000 |
| Winona | 900,000 | ......... | ......... | 900,000 |
| Wolverine | 230,000 | 990,000 | 760,000 | ........ |
| Wyandot | 700,000 | ......... | ......... | 700,000 |
| Totals | $46,038,700 | $117,685,920 | $71,647,220 | ........ |

## CAPITALIZATION OF LAKE COPPER COMPANIES.

The following table shows number of shares authorized, number issued, and total capitalization of active Lake Superior copper mining corporations:

| Name of Company. | Organized under laws of | No. shares authorized. | No. shares issued. | Gross Capitalization. |
|---|---|---|---|---|
| Adventure Cons | Mich. | 100,000 | 100,000 | $2,500,000 |
| Allouez | Mich. | 100,000 | 100,000 | 2,500,000 |
| Arcadian | N. J. | 150,000 | 150,000 | 3,750,000 |
| Arnold | Mich. | 100,000 | 100,000 | 2,500,000 |
| Atlantic | Mich. | 100,000 | 100,000 | 2,500,000 |
| Ashbed | Mich. | 40,000 | 40,000 | 1,000,000 |
| Calumet & Hecla | Mich. | 100,000 | 100,000 | 2,500,000 |
| Centennial | Mich. | 100,000 | 90,000 | 2,500,000 |
| Central | Mich. | 20,000 | 20,000 | 500,000 |
| Copper Range | Mich. | 100,000 | 100,000 | 2,500,000 |
| Copper Range Cons | N. J. | 285,000 | ...... | 28,500,000 |
| Champion | Mich. | 100,000 | 100,000 | 2,500,000 |
| Elm River | N. J. | 100,000 | 100,000 | 2,500,000 |
| Franklin | Mich. | 100,000 | 100,000 | 2,500,000 |
| Humboldt | Mich. | 40,000 | 40,000 | 1,000,000 |
| Isle Royale | N. J. | 150,000 | 150,000 | 3,750,000 |
| Mohawk | Mich. | 100,000 | 100,000 | 2,500,000 |
| Mayflower | Mich. | 100,000 | 100,000 | 2,500,000 |
| Mass Consolidated | Mich. | 100,000 | 100,000 | 2,500,000 |
| Michigan | Mich. | 100,000 | 100,000 | 2,500,000 |
| National | Mich. | 100,000 | 40,000 | 2,500,000 |
| Old Colony | Mich. | 100,000 | 100,000 | 2,500,000 |
| Osceola Consoldiated | Mich. | 100,000 | 96,150 | 2,500,000 |
| Phœnix | Mich. | 100,000 | 100,000 | 2,500,000 |
| Quincy | Mich. | 100,000 | 100,000 | 2,500,000 |
| Rhode Island | Mich. | 100,000 | 100,000 | 2,500,000 |
| St. Mary's Mineral Land Co. | N. J. | 200,000 | 140,000 | 5,000,000 |
| Tamarack | Mich. | 60,000 | 60,000 | 1,500,000 |
| Tecumseh | Mich. | 100,000 | 40,000 | 2,500,000 |
| Trimountain | Mich. | 100,000 | 100,000 | 2,500,000 |
| Union C. L. & M. Co | Mich. | 100,000 | 80,000 | 2,500,000 |
| Victoria | Mich. | 100,000 | 100,000 | 2,500,000 |
| Winona | Mich. | 100,000 | 100,000 | 2,500,000 |
| Washington | Mich. | 100,000 | 60,000 | 2,500,000 |
| Wolverine | Mich. | 60,000 | 60,000 | 1,500,000 |
| Wyandot | Mich. | 100,000 | 100,000 | 2,500,000 |
| Total capitalization | | | | $114,500,000 |

## FORCES EMPLOYED BY MINES.

1889–1902.

| Year. | Michigan. Number of Employes. | Michigan. Number of Fatalities. | Michigan. Percentage Fatalities. | Montana. Number of Employes. | Montana. Number of Fatalities. | Montana. Percentage Fatalities. |
|---|---|---|---|---|---|---|
| 1889... | 6,480 | 21 | .30 | .... | .. | ... |
| 1890... | 7,310 | 35 | .48 | .... | .. | ... |
| 1891... | 7,702 | 28 | .36 | .... | .. | ... |
| 1892... | 7,640 | 21 | .27 | .... | .. | ... |
| 1893... | 7,591 | 23 | .30 | .... | .. | ... |
| 1894... | 7,348 | 22 | .30 | .... | .. | ... |
| 1895... | 7,249 | 46 | .63 | .... | .. | ... |
| 1896... | 8,170 | 19 | .23 | .... | .. | ... |
| 1897... | 8,726 | 26 | .30 | .... | .. | ... |
| 1898... | 10,469 | 23 | .22 | 6,548 | .. | ... |
| 1899... | 13,051 | 27 | .20 | .... | .. | ... |
| 1900... | 13,971 | 36 | .25 | 6,929 | .. | ... |
| 1901... | 13,498 | 33 | .24 | .... | .. | ... |
| 1902... | 14,130 | 44 | .31 | 8,100 | 33 | .41 |

## NUMBER SHAREHOLDERS IN LAKE COPPER COMPANIES.

1896–1902.

| Company. | 1896. | 1897. | 1898. | 1899. | 1900. | 1901. | 1902. |
|---|---|---|---|---|---|---|---|
| Calumet & Hecla | 2,464 | 2,590 | 2,716 | 2,859 | 3,080 | 3,413 | 3,425 |
| Osceola | 823 | 900 | 1,477 | 1,522 | 1,512 | 1,793 | 1,985 |
| Quincy | 978 | 1,041 | 1,445 | 1,449 | 1,540 | 1,477 | 1,557 |
| Franklin | 458 | 461 | 442 | 550 | 945 | 1,037 | 1,311 |
| Tamarack | 1,178 | 1,371 | 1,353 | 1,157 | 1,169 | 1,241 | 1,286 |
| Wolverine | 333 | 445 | 625 | 688 | 892 | 1,099 | 1,223 |
| Rhode Island | .... | .... | .... | 97 | 1,100 | 1,256 | 1,216 |
| Victoria | .... | .... | .... | .... | 796 | 1,001 | 1,206 |
| Adventure | .... | .... | .... | 431 | 1,046 | 1,288 | 1,050 |
| Mohawk | .... | .... | .... | 61 | 594 | 940 | 951 |
| Michigan | .... | .... | .... | 22 | 592 | 775 | 933 |
| Winona | .... | .... | .... | 468 | 637 | 736 | 909 |
| Wyandot | .... | .... | .... | .... | .... | .... | 833 |
| Trimountain | .... | .... | .... | .... | 780 | 882 | 730 |
| Old Colony | .... | .... | .... | .... | 598 | 626 | 721 |
| Centennial | .... | .... | 438 | 337 | 439 | 550 | 597 |
| Mayflower | .... | .... | .... | .... | 399 | 423 | 587 |
| Phœnix | .... | .... | .... | .... | 352 | 408 | 582 |
| Allouez | .... | .... | .... | 449 | 465 | 510 | 554 |
| Atlantic | 364 | 400 | 401 | 300 | 374 | 408 | 417 |
| Central | .... | .... | .... | 196 | 203 | 220 | 189 |
| Baltic | .... | .... | .... | 486 | 513 | 582 | 177 |
| Copper Range Consolidated | .... | .... | .... | .... | .... | .... | 121 |
| Champion | .... | .... | .... | .... | .... | .... | 8 |
| Totals | 6,598 | 7,208 | 8,897 | 11,072 | 18,026 | 20,665 | 22,568 |

## FUTURE PRODUCTION OF COPPER.

### 1901-2000.

The safest guide to the future is the history of the past. In the following tables an effort is made to estimate the probable production of copper for the future, basing such estimates upon the outputs of the past. The preliminary table next following gives a summary of the production of the Nineteenth century, by decades, with percentages of increase for each decade:

*(Long Tons.)*

| Decade. | Total Production. | Yearly Average. | Percentage of Increase |
|---|---|---|---|
| 1801-1810...... | 91,000 | 9,100 | .... |
| 1811-1820...... | 96,000 | 9,600 | 5.60 |
| 1821-1830...... | 135,000 | 13,500 | 40.62 |
| 1831-1840...... | 218,400 | 21,840 | 61.77 |
| 1841-1850...... | 291,000 | 29,100 | 33.24 |
| 1851-1860...... | 506,999 | 50,699 | 74.22 |
| 1861-1870...... | 900,000 | 90,000 | 77.51 |
| 1871-1880...... | 1,189,000 | 118,900 | 32.11 |
| 1881-1890...... | 2,373,398 | 237,339 | 99.44 |
| 1891-1900...... | 3,708,901 | 370,890 | 56.22 |

Analysis of these figures shows that the average decennial percentage of increase for the century was 53.91%; for the last half of the century, 67.90%, and for the last twenty years, during which the electrical industry became a great consumer of copper, the average decennial increase in copper output was 77.83%. Measured by decades the increase in copper production during the Nineteenth century was forty-fold, from the first decennium to the last, while measured by years, and estimating the production of 1801 at 9,000 tons, the production of 1900, which amounted to 486,363 tons, was just fifty-fold as great as one hundred years earlier. A fifty-fold increase in production during the present century would give an output of 24,318,150 tons of copper for the year 2000.

The actual annual percentage of increase for the Nineteenth century was a very small fraction more than 4%, measuring outputs by decades, and a fraction over 4%, measuring annual products from 1801 to 1900, inclusive. In order to show the actual increase in production by decades, as compared with the theoretical increase at 4% yearly, the appended table is given, 4% being figured as equal to 50% increase in 10 years, though actually but 48.02%:

*(Long Tons.)*

| Year. | Actual Average. | Theoretical Average. |
|---|---|---|
| 1810...................... | 9,100 | 9,000 |
| 1820...................... | 9,600 | 13,500 |
| 1830...................... | 13,500 | 19,750 |
| 1840...................... | 21,840 | 29,625 |
| 1850...................... | 29,100 | 44,437 |
| 1860...................... | 50,699 | 66,656 |
| 1870...................... | 90,000 | 99,984 |
| 1880...................... | 118,900 | 149,992 |
| 1890...................... | 237,339 | 224,964 |
| 1900...................... | 370,890 | 337,447 |

The foregoing table shows very plainly the effect of electrical demand for the metal, which first became a factor of importance in the ninth decade, shortly after 1880. Previous to that decade the theoretical increase of 4% annually, compounded, exceeds the actual increase in every decade, but after 1880 the actual increase exceeds the theoretical ratio. The actual copper output of 1900 was 486,732 tons, and the theoretical output for that year, based on the average of the decade 1890–1900, with 21⅔% increase for 5 years from the mean of 1895, would have been 410,560 tons. It is evident that the average ratio of increase of slightly more than 4% yearly, which ruled during the Nineteenth century, is not the factor of the present electrical age. What that factor may be is uncertain. The electrification of the globe, while wonderful progress has been made, is not yet a sufficiently established fact to give accurate data for an average ratio of increase in consumption.

The ratio of increase in copper production of the world has been 6% to 8% for several years past. It has grown to be considered an axiom in the copper trade that the normal increase is 8% yearly, but this ratio, while it may be considered the present factor, has not been established for a sufficiently long time to be assured for an indefinite time in the future. The following table gives hypothetical outputs for every tenth year during the Twentieth century, based upon various percentages of increase, all figured from the actual production of the closing year of the Nineteenth century. The compound increases, for facility in computation, are taken at slight changes from their actual value, as, for instance, 4% compounded for ten years is figured as 50% increase, instead of 48.02%, the actual figure; 5% is figured at 60%, instead of 62.89%; 7% compounded is figured as 80% in ten years, instead of 79.02%; 8% is figured as only 110% instead of 115.89.

(*Long Tons.*)

| Year. | At 4%. | At 5%. | At 7%. | At 8%. |
|---|---|---|---|---|
| 1900...... | 486,732 | 486,732 | 486,732 | 486,732 |
| 1910...... | 730,098 | 778,771 | 876,117 | 1,022,137 |
| 1920...... | 1,095,147 | 1,246,033 | 1,577,011 | 2,146,488 |
| 1930...... | 1,642,720 | 1,993,654 | 2,838,621 | 4,507,625 |
| 1940...... | 2,464,080 | 3,189,846 | 5,126,317 | 9,466,012 |
| 1950...... | 3,696,121 | 5,103,754 | 9,227,372 | 19,878,626 |
| 1960...... | 5,544,181 | 8,166,007 | 16,609,269 | 41,745,115 |
| 1970...... | 8,316,272 | 13,065,612 | 29,896,685 | 87,664,741 |
| 1980...... | 12,474,408 | 20,904,980 | 53,914,033 | 184,095,956 |
| 1990...... | 18,711,613 | 33,447,968 | 97,045,260 | 386,601,507 |
| 2000...... | 28,067,419 | 52,516,748 | 174,681,468 | 811,863,165 |

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THE annual publication of the Copper Handbook necessitates the constant gathering and systematic filing of accurate information regarding the technics and statistics of copper and the copper trade generally, also the securing and filing of data covering the finances, organization, equipment, development, ores, management and prospects of several thousand copper mines and copper mining companies in all parts of the world.

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## NOW READY

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## 1903

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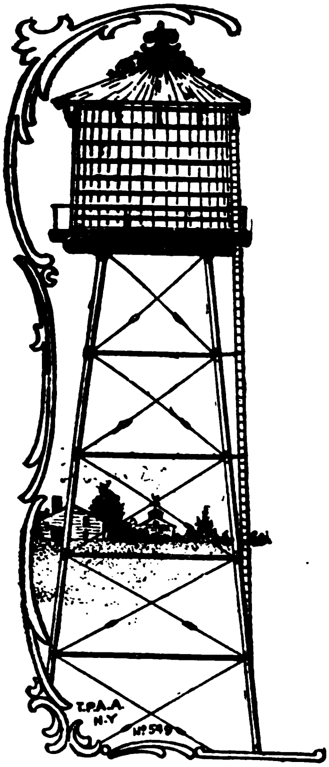

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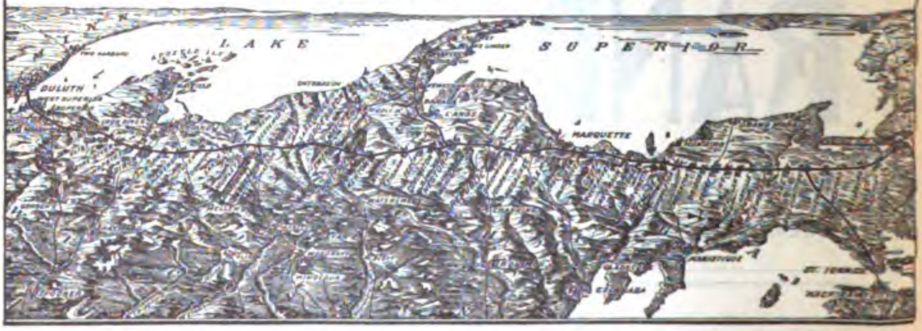

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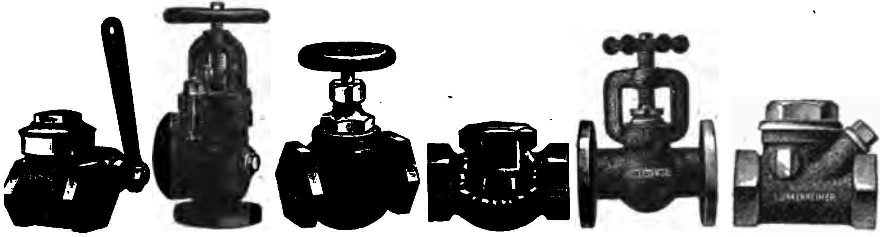

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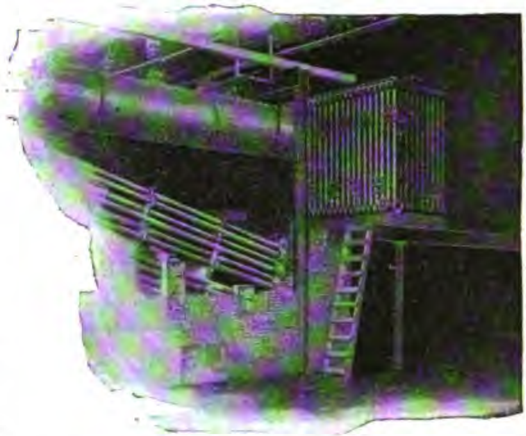

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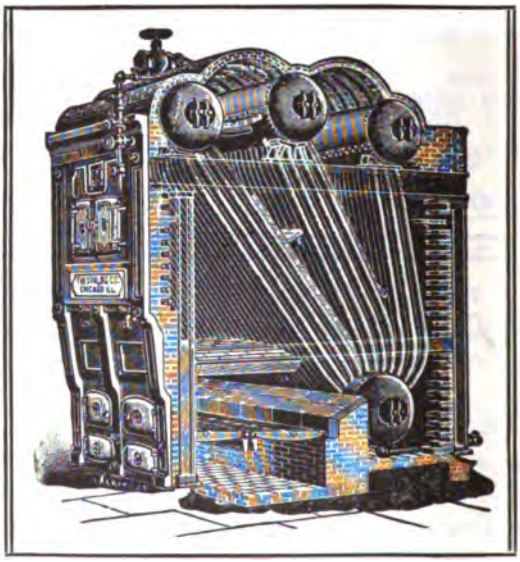

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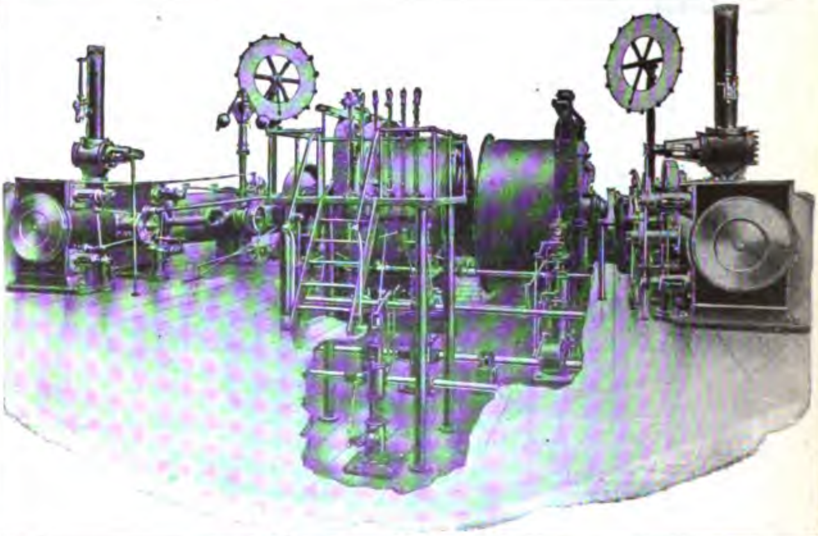

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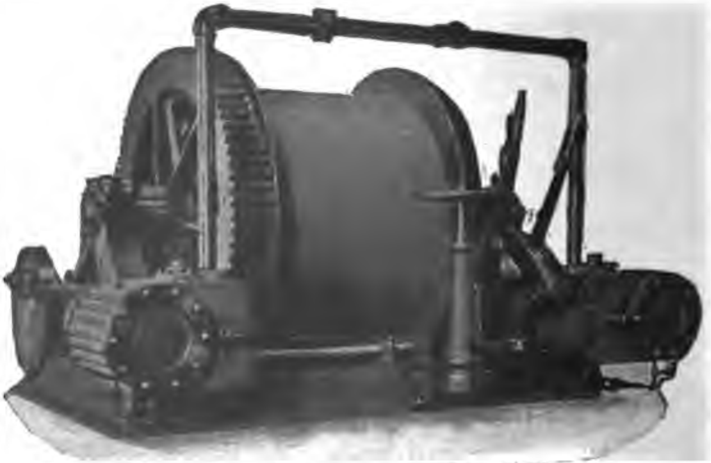

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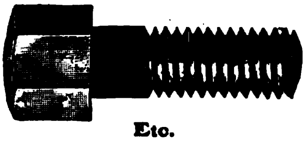

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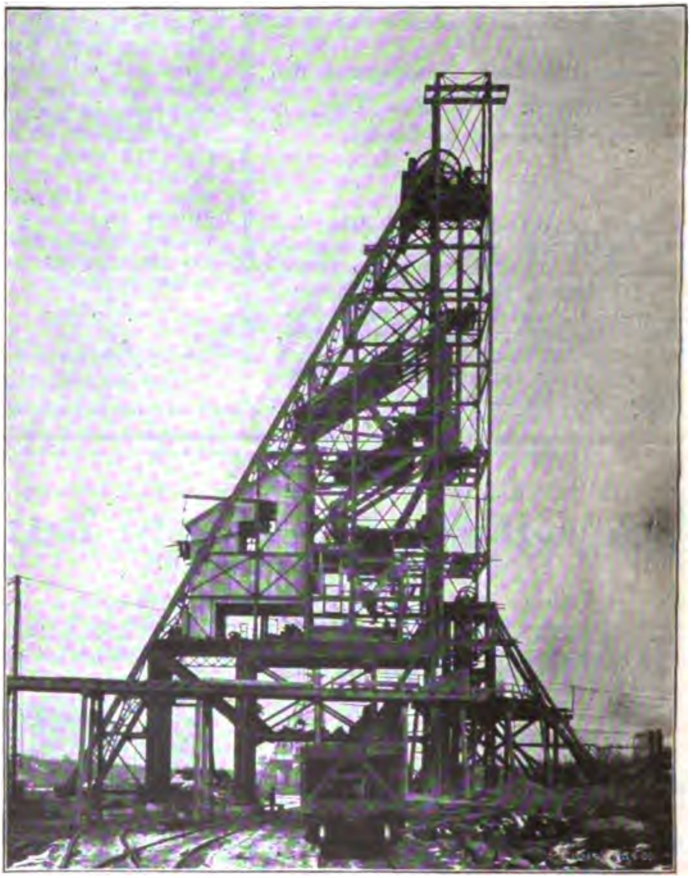

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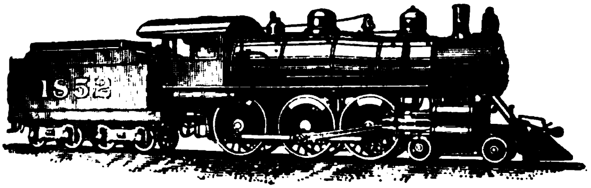

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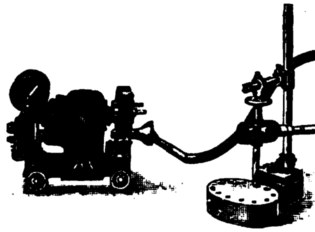

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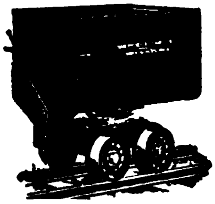

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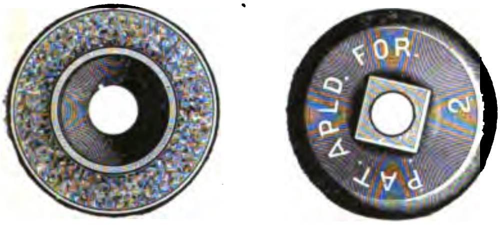

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